EXHIBIT 17

UNITED STATES DISTRICT COURT

NORTHERN DISTRICT OF CALIFORNIA

SAN FRANCISCO DIVISION

HUAWEI TECHNOLOGIES CO., LTD., HUAWEI DEVICE USA, INC., and HUAWEI TECHNOLOGIES USA, INC., Plaintiff(s)/Counterclaim Defendants, vs. Samsung ELECTRONICS CO., LTD, Samsung ELECTRONICS AMERICA, INC., Defendants / Counterclaim-Plaintiffs, and Samsung RESEARCH AMERICA, INC., Defendant, v. HISILICON TECHNOLOGIES CO., LTD., Counterclaim-Defendant.	Case Number: 3:16-cv-2787-WHO

REBUTTAL EXPERT REPORT OF DR. ZHI DING

Contents

I. INTRODUCTION

1. My name is Zhi Ding, and I have been retained as a technical expert by counsel for Plaintiffs Huawei Technologies Co. Ltd., Huawei Device USA Inc., Huawei Technologies USA Inc. and HiSilicon Technologies Co Ltd. ("Huawei") (collectively "Plaintiffs") to provide assistance in the above-captioned matter against Defendants Samsung Electronics Co., Ltd., Samsung Electronics America, Inc., and Samsung Research America, Inc. ("Samsung") (collectively "Defendants").

II. QUALIFICATIONS AND PROFESSIONAL EXPERIENCE

2. I am presently serving as Professor in the Department of Electrical and Computer Engineering at University of California, Davis, California, a position I have held since my appointment on July 1, 2000. I am also a private technical consultant on various information system related technologies. I have more than three decades of research experience on a wide range of topics related to data communications and signal processing.

3. I received a Ph.D. in Electrical Engineering from Cornell University, New York (1990); a Master of Applied Science degree in Electrical Engineering from University of Toronto, Canada (1987); and a Bachelor's degree in Wireless Engineering from Nanjing Institute of Technology (later renamed Southeast University), China (1982).

4. My professional responsibilities as a Professor at University of California, Davis, include classroom instruction on various topics of communications systems and signal analysis, as well as mentoring undergraduate students and supervising graduate students' research and development efforts on various topics related to information systems, communications, and signal processing technologies. I have directly supervised basic research and development works ranging from signal detection to wireless networking. As the chief academic advisor, I have also directly

supervised the completion of more than 18 Master's theses and 25 Ph.D. dissertations on various topics related to digital communications. I have served full time as a faculty member at three major research universities in the United States over the past 28 years, including Auburn University from 1990 to 1998, University of Iowa from 1999 to 2000, and University of California, Davis, from 2000 to present.

5. Since 1990, I have served as the principal investigator of multiple highly competitive federal and local research grants, including sixteen major research projects supported by the National Science Foundation and two research projects funded by the U.S. Army Research Office. These competitive research projects focused on developing more efficient and effective digital communications transceivers, networks, and signal processing algorithms and tools. I have also participated in three large-scale projects supported by the Defense Advanced Research Projects Agency (DARPA) with teams of researchers. I have applied for, and received support from, other federal, state, and industry sponsors.

6. I have published over 170 peer-reviewed research articles in premier international journals, in addition to over 220 publications at top international conferences on communications and signal processing. I also authored two books on communications technologies. My most recent book, co-authored with B.P. Lathi, is entitled, "Modern Digital and Analog Communication Systems," 5th edition, and was published by the Oxford University Press in 2018. This previous edition of this book by the same authorship was widely adopted as an introductory textbook to communications systems.

7. I am a Fellow of the Institute of Electrical and Electronics Engineers (IEEE), and was elected in January 2003 for contributions made in signal processing for communications. The IEEE is the world's largest professional society of engineers, with over 400,000 members in more

than 160 countries. The IEEE has led the development of many standards for modern digital communications and networking, most notably, the IEEE 802 series of WiFi network standards. The IEEE Grade of Fellow is conferred by the Boards of Directors upon a person with an extraordinary record of accomplishments in any of the IEEE fields of interest. The total number selected in any one year does not exceed one-tenth of one percent of the total voting Institute membership.

8. I have served the IEEE in the following capacities:

- Chief Information Office, IEEE Communications Society, 2018 — Present.
- General Chair of the 2016 IEEE International Conference on Acoustics, Speech, and Signal Processing, the flagship conference of the IEEE Signal Processing Society.
- Chair of the Steering Committee for the IEEE Transactions on Wireless Communications (2008-2010).
- Distinguished Lecturer of the IEEE Communications Society from January 2008 to December 2009.
- Technical Program Chair of the 2006 IEEE Globecom, one of two flagship annual IEEE Communication Society conferences.
- Distinguished Lecturer of the IEEE Circuits and Systems Society from 2004 to 2005.
- Associate Editor of the IEEE Transactions on Signal Processing from 1994 to 1997 and 2001 to 2004.
- Member of the IEEE Statistical Signal and Array Processing for Communications Technical Committee from 1993 to 1998.

- Member of the IEEE Signal Processing for Communications Technical Committee from 1998 to 2004.

9. In 2012, I received the annual Wireless Communications Technical Committee Recognition Award from the IEEE Communications Society, a peer award given to a person with a high degree of visibility and contribution in the field of "Wireless and Mobile Communications Theory, Systems, and Networks."

10. I have also served as a technical consultant for the telecommunications industry. For example, in 1995, I consulted for Analog Devices, Inc., on the development of first generation DOCSIS cable network modems. I have also consulted for other companies, including Nortel Networks, NEC US Laboratories, and Futurewei. I worked as a visiting faculty research fellow at NASA Glenn Research Center in 1992 and at U.S. Air Force Wright Laboratory in 1993. I have served on multiple review panels of the National Science Foundation to evaluate competitive research proposals in the field of communications. I have also reviewed a large number of research proposals at the request of the National Science and Engineering Research Council (NSERC) of Canada as an expert panelist from 2010 to 2013, and also at the request of the Research Grant Council (RGC) of Hong Kong as an external reviewer.

11. I have served as expert witness or consulting expert on a number of matters related to intellectual property, especially in the arena of wireless communications, including cellular communications and Wi-Fi technologies in particular. From my prior experience, I have developed expertise in assessing the essentiality and technical value of patents, particularly with respect to the 2G, 3G, and 4G cellular standards and associated technologies such as Wi-Fi. For example, since 2007, I have been engaged in extensive expert work on various litigations involving patents alleged to be essential to cellular and Wi-Fi standards. In connection with my works on the present

litigation, I applied such knowledge and expertise when analyzing select patents, as described in further detail below.

12. A true and accurate copy of my curriculum vitae is attached as **Appendix A** to this report. My C.V. contains a list of major publications that I have authored in the previous 30 years. I am being compensated at my usual rate of $615 per hour for my time spent on this matter. My compensation is in no way contingent on the content of my opinions expressed in this matter, or the outcome of this matter.

III. MATERIALS CONSIDERED IN FORMING MY OPINIONS

13. Attached as **Appendix B** to this report is a list of materials that I have considered in reaching my opinion. In forming my opinions, I considered the materials cited in the expert report of Michael A.M. Davies ("Davies Rep."), and the materials cited herein. I am prepared to use those materials, other materials that may be produced during the course of this proceeding, and supplemental charts and other demonstratives and representations based on those materials to support my testimony at trial.

IV. ASSIGNMENT AND SUMMARY OF OPINIONS

14. I was asked to review and respond to the report of Michael A.M. Davies, an expert retained by Samsung. In particular, I was asked to review and respond to Mr. Davies' opinions about non-infringing alternatives to certain Huawei patents. I was also asked to assess the similarities or differences between certain patents owned by Unwired Planet and the patents asserted by Samsung and Huawei in this case, in response to Mr. Davies' opinions related to Unwired Planet patents.

15. Based on my analysis, I have concluded that Mr. Davies has not identified any viable non-infringing alternatives to the Huawei patents he evaluates.

16. Based on my analysis, I have also concluded that the patents owned by Unwired Planet identified by Mr. Davies are not technically comparable to the patents asserted by Huawei in this case. The Unwired Planet patents would have been seen as substantially different from the Huawei Patents from a technical perspective. I have further concluded that Mr. Davies has not identified a sufficient basis to establish that the Unwired Planet patents are technically comparable to the patents asserted by Samsung in this case.

V. THE ABSENCE OF NON-INFRINGING ALTERNATIVES TO CERTAIN HUAWEI PATENTS

17. In this section, I review and respond to Mr. Davies' opinions about non-infringing alternatives to certain Huawei patents.

A. U.S. PATENT APPLICATION PUBLICATION NO. 2013/0028192 A1 ('192)

1. SUMMARY OF THE '192 PATENT APPLICATION

18. U.S. Patent Application Publication No. 2013/0028192 A1 ("the '192 Patent Application"), *Method, user equipment and base station for transmitting uplink control information*, with a priority date of April 7, 2010, granted as US Patent No. 8,797,967, is according to Mr. Davies the U.S. counterpart to patent CN201010146531 in the same patent family.[1] The applications are held by Huawei.

19. The '192 Patent Application discloses a novel method and apparatus (user equipment and base station) for transmitting Uplink Control Information (UCI) in a 4G LTE cellular system when carrier aggregation is used for enhanced connection speed.

20. More specifically, carrier aggregation (CA) allows the eNB and the UE to use the joint spectra of two or more component carriers (CCs) to provide larger transmission bandwidth.

[1] Actually, Mr. Davies is mistaken. The U.S. counterpart to CN201010146531 is U.S. Patent No. 9,807,741.

Each activated downlink CC has its own unique UCI that must be transmitted by the user equipment to the eNB, including such control information such as Channel Quality Information (CQI), Precoding Matrix Indicator (PMI), scheduling request (SR) or Hybrid Automatic Repeat Request (HARQ) acknowledgement (ACK/NACK). One of the main problems in CA is the need for eNB to decode correctly UCI when the total number of bits in the UCI sent by the UE must include UCI for multiple activated CC. The pre-existing method of encoding the UCI for a single carrier cannot be directly used in CA since the eNB

> needs to learn the total number of bits of the original information of UCI (Uplink Control Information) joint channel coding adopted by a UE, that is, to ensure that the eNB and UE have consistent understating on the total number of bits of the original information of UCI joint coding of multiple downlink carriers, so as to perform correct decoding. However, the existing method for transmitting UCI causes the eNB to decode the jointly encoded UCI incorrectly.

'192 Patent Application at ¶ [0004].

The '192 Patent Application discloses an invention that provides a method, a UE and an eNB for transmitting joint UCI in CA so as to avoid the problem that the eNB decodes the jointly coded UCI incorrectly.

21. The invention requires that the eNB transmitting, and the UE receiving, a carrier activation command or a carrier deactivation command in a downlink subframe n. From this command, the UE shall update its downlink activated carrier set according to the received carrier activation/deactivation command into a second downlink activated carrier set. The second downlink activated carrier set is taken by the UE as a current downlink activated carrier set

corresponding to a first uplink subframe which must belong to a subframe set consisting of uplink subframe n+k and subframes thereafter.

22. It is required by the method disclosed in the application that the affected uplink subframe must be such that the positive integer k is greater than or equal to 5. In other words, the first possible effective uplink subframe after CA update may be subframe n+5.

23. To form the jointly coded UCI in CA, the UE shall sort X piece(s) of UCI corresponding to X downlink carrier(s) that belong to the current activated carrier set according to a sorting rule, wherein X is a positive integer. The UE shall then transmit the sorted X pieces of UCI to an eNB in the first uplink subframe which must be after subframe n+5.

24. With respect to the sorting and the innovation aspect of the '192 Patent Application, '192 proposes a sorting rule that is shared by both the UE and the eNB. The sorting rule allows the UE to organize the UCI from multiple CCs to be encoded in such a way that the eNB receiver can determine which piece of information corresponds to each carrier based on the pre-set rule. '192 Patent Application at ¶¶ [0032]-[0035].

25. More specifically, the '192 Patent Application discloses an inventive method for UCI transmission involving CA in 4G-LTE network, as is reflected in Claim 1:

> *1. A method for transmitting uplink control information, comprising:*
>
> *receiving, by a user equipment (UE), a carrier activation command or a carrier deactivation command in a downlink subframe n;*
>
> *updating, by the UE, a first downlink activated carrier set according to the received carrier activation command or the carrier deactivation command into a second downlink activated carrier set;*

taking, by the UE, the second downlink activated carrier set as a current downlink activated carrier set corresponding to a first uplink subframe; wherein the first uplink subframe belongs to a subframe set of an uplink subframe n+k and uplink subframe(s) after the uplink subframe n+k; and wherein n or k is a positive integer, and k is greater than or equal to 5:

sorting, by the UE, X piece(s) of Uplink Control Information (UCI) corresponding to X downlink carrier(s) according to a sorting rule, wherein X is a positive integer, and the X downlink carrier(s) belong to the current downlink activated carrier set; and

transmitting, by the UE, the sorted X pieces of UCI to a base station in the first uplink subframe.

2. KEY ELEMENTS OF THE '192 PATENT APPLICATION'S INVENTION

26. Mr. Davies' reports that, according to the '192 Patent Application, before the invention,

> base stations incorrectly decoded the jointly coded UCI they received from the user equipment, because the base station and user equipment lacked a common understanding of the number of bits of the original UCI after coding. The '192 Patent Application proposes an alternative method by:
>
> > *Establishing a common understanding of the length of the message between the user equipment and the base station.*
>
> The '192 Patent Application asserts that prior to the invention it put forth, base stations lacked a way of identifying which piece of UCI corresponded to a particular downlink carrier. The '192 Patent Application proposes to solve this problem by:

> *Organizing the information to be transmitted in such a way that the receiver can determine which piece of information corresponds to each carrier.*

Davies Rep. at ¶¶ 42-43.

27. Mr. Davies' summary does not fully capture the inventive aspect of the '192 Patent Application. As can be seen from the representative claim (Claim 1) above, the invention includes the steps of (a) the UE receiving the carrier activation/deactivation command in a downlink subframe n from the eNB; (b) the UE updating the current activated downlink carrier set based on the received command in downlink subframe n; (c) the UE taking the current activated downlink carrier set to correspond to a first uplink subframe with subframe index n+k, wherein k is a positive integer greater than or equal to 5; (d) the UE sorting X pieces of UCI corresponding to X activated downlink carriers that belong to the current activated downlink carrier set according to a sorting rule; and (e) the UE transmitting the sorted UCI.

28. Mr. Davies' report only focused on steps (d) and (e) in the disclosed invention, and thereby neglected the importance of receiving and updating the current activated downlink carrier set in steps (a) and (b), without which steps (d) and (e) would not be possible. Furthermore, Davies' report failed to recognize the significance of sending the UCI on uplink subframes with indices of n+k in which k is a positive integer greater than or equal to 5 (step (c)). Requiring the transmission of UCI on uplink subframes with indices of n+k to correspond to the updated downlink carrier set based on command sent in downlink subframe n provides the necessary time that the UE requires to perform the necessary computation. In addition, the '192 Patent Application discloses such a delay allows both the eNB and the UE to synchronize the effective time of the carrier activation/deactivation command:

> The first effective uplink subframe n+k refers to a first uplink subframe which needs to report UCI and which the UE encounters after k subframes since the

> subframe n on which the UE receives the carrier activation command/deactivation command. A specific value of k may be selected according to an actual situation, for example, k is greater than or equal to 5.
>
> Specifically, when UCI is ACK/NACK, the X downlink carrier(s) are all downlink carriers in the downlink carrier set of the UE: when UCI is CSI, the X downlink carrier(s) may be determined according to the downlink activated carrier set of the UE, CSI configuration configured by higher layers and whether aperiodic CSI is to be reported.

'192 Patent Application at ¶ [0161]-[0162]

> It should be noted that, in this step, starting from the first effective uplink subframe n+k, the UE uses the updated downlink activated carrier set (that is, the downlink activated carrier set updated after the UE receives the carrier activation/deactivation command in the downlink subframe n) as the current downlink activated carrier set, until the update needs to be performed again according to new carrier activation command/deactivation command.

Id. at ¶ [0164]

> When the UE reports UCI, by delaying effective time of the carrier activation command/deactivation command, the problem that the base station decodes the jointly coded UCI incorrectly due to inconsistent understanding of the UE and eNB on the total number of original information bits of UCI joint coding of multiple downlink carriers may be solved.

Id. at ¶ [0010]

3. ESSENTIALITY OF THE '192 PATENT APPLICATION'S INVENTION

29. Exploiting the novelties and the advantages of the invention in the '192 Patent Application, 3GPP has adopted the invention in its 4G-LTE standard. Specifically, utilizing the invention, Sections 5.2.2.6 and 5.2.4.1 of 3GPP TS 36.212 V14.4.0 describe the channel coding of uplink control information (UCI) when carrier aggregation is involved. The activation of deactivation of additional secondary cells (component carriers) is disclosed in Section 5.13 of 3GPP TS 36.321 V14.4.0.

4. PERSON OF ORDINARY SKILL IN THE ART (POSITA) ALTERNATIVES

30. Mr. Davies' report suggests that,

> many alternatives existed to the element of the '192 Patent Application that holds that a common understanding of the length of the UCI after channel coding must be established between the user equipment and the base station, to ensure the base station correctly decodes the jointly coded UCI in an LTE-A system with carrier aggregation. Additionally, many alternatives existed to establish the correspondence between a piece of UCI and a downlink carrier beyond the sorting of the UCI pieces according to a preset sorting rule.

Davies Rep. at ¶ 44.

31. Mr. Davies' suggestions regarding the identity of these "many alternatives" include "Labeling", "Preamble", "Look-Up Table", "Stop Message", and "Patent Alternatives". I disagree that these would have been considered alternatives by a POSITA, as I explain further below.[2] *Id.* at ¶¶ 44-56.

---

[2] I adopt, for purposes of this report, Mr. Davies' definitions of a POSITA for each of the patents and patent applications at issue. Davies Rep. at ¶¶ 28-31.

a) HINDSIGHT

32. Mr. Davies applied hindsight unavailable to a POSITA in proposing his so-called "(POSITA) Alternatives." Mr. Davies does not identify or rely upon any prior art references, or cite any evidence at all, to support his opinion that a POSITA would have known about these alleged alternatives. Mr. Davies appears to have made up these "(POSITA) Alternatives" based on hindsight.

b) "LABELING" IS NOT AN ALTERNATIVE

33. Davies suggests that instead of reaching a common understanding regarding the encoding and decoding of joint UCI from multiple CCs *a priori* between the UE and the eNB when transmitting UCI, the UE may "label each of the pieces of UCI with a number, as well as an indication of how many total pieces of UCI are contained in the activated downlink carrier set." *Id*. at ¶ 45. Mr. Davies claims that this "labeling" alternative would "obviate the need of the base station and the user equipment to calculate the number of bits of UCI after channel coding." *Id*.

34. Mr. Davies fails to point out that this "labeling" approach would require additional label information be transmitted in addition to the jointly coded UCI. The additional labeling information would consume further uplink bandwidth. Instead of letting the eNB compute the total number of UCI bits and identifying the UCI for the activated carrier set transmitted by the UE, "labeling" would trade the more precious and limited bandwidth resources for small amount of computation saving by the basestation (eNB). A person of ordinary skill in the art would recognize such trade to be ill-conceived, particularly as the computation capability of the eNB is particularly strong. Instead of robbing the uplink bandwidth which could otherwise be used for faster data transmission, a POSITA would have certainly recognized this alternative to be undesirable.

35. Furthermore, a person of ordinary skill in the art would recognize that the suggested labeling would be totally incompatible with the previously existing UCI transmission for single carrier connections before the introduction of CA. A POSITA would have recognized that this lack of compatibility would increase the complexity of UE encoder and eNB receiver.

36. Mr. Davies fails to recognize that the inventive aspect of the '192 Patent Application allows the UE to sort the joint UCI information to be coded such that the eNB can uniquely separate the UCI for each activated downlink carrier without any additional bandwidth consumption. This is similar to pre-sorting X customer orders to a merchant based on a sorting rule such that the merchant knows which customer each order is from without having to write down on each order the name or other identification of the customer. Mr. Davies argues that his proffered labeling methodology would "ensure that the base station understood how many UCI pieces it should receive. If the base station did not receive the expected number of UCI pieces, it could identify the missing piece and request that it be retransmitted." *Id*. However, Mr. Davies fails to point out that a person of ordinary skill in the art would recognize this approach to be undesirable to wireless operators as it would require even more bandwidth resources, and therefore would not be an acceptable alternative to the '192 Patent Application for a POSITA.

c) "PREAMBLE" IS NOT AN ALTERNATIVE

37. Mr. Davies suggests that instead of reaching a common understanding regarding the encoding and decoding of joint UCI from multiple CCs *a priori* between the UE and the eNB when transmitting UCI, an alternative "would have been to affix a preamble to the jointly channel coded UCI describing how many total pieces of UCI are contained in the activated downlink carrier set." *Id*. at ¶ 47.

> Additionally, a POSITA would have known that a plausible alternative to sorting each piece of UCI according to a preset sorting rule to decipher which piece of UCI was associated with which downlink carrier, would be affixing a preamble to the jointly channel coded UCI describing the relationship of each piece of UCI to each downlink carrier.

Id. at ¶ 48.

38. Mr. Davies recognizes that this alternative of "preamble" is equivalent to the alternative of labeling.

> The preamble methodology is more explicit than sorting according to a preset sorting rule laid out by the '192 Patent Application, but less explicit than the labeling, as it only establishes the correspondence between the pieces of UCI and downlink carriers at the beginning of the jointly channel coded UCI message.

Id.

Therefore, given that the only difference between preamble and labeling is the position of the jointly channel coded UCI message, a person of ordinary skill in the art would recognize that the suggested preamble alternative suffers from the same shortcomings as the suggested preamble alternative.

39. Mr. Davies' suggested use of preamble would require additional preamble bits be transmitted in addition to the jointly coded UCI. The additional preamble information would consume further uplink bandwidth. Instead of letting the eNB compute the total number of UCI bits and identifying the UCI for the activated carrier set transmitted by the UE, "labeling" would trade the more precious and limited bandwidth resources for small amount of computation saving by the basestation (eNB). A person of ordinary skill in the art would recognize such trade to be

ill-advised, particularly as the computation capability of the eNB is particularly strong. Because a preamble methodology would rob the uplink bandwidth, which could otherwise be used for faster data transmission, a POSITA would have recognized this alternative to be undesirable. Furthermore, a POSITA would recognize that sending a preamble to UCI would be totally incompatible with the previously existing UCI transmission for single carrier connections before the introduction of CA. A POSITA would have recognized that this lack of compatibility would increase the complexity of UE encoder and eNB receiver.

40. Mr. Davies fails to recognize that the inventive aspect of the '192 Patent Application allows the UE to sort the joint UCI information to be coded such that the eNB can uniquely separate the UCI for each activated downlink carrier without any additional bandwidth consumption. This is similar to pre-sorting X customer orders to a merchant based on a sorting rule such that the merchant knows which customer each order is from without having to write down on each order the name or other identification of the customer. Mr. Davies suggest that an alternative "would be affixing a preamble to the jointly channel coded UCI describing the relationship of each piece of UCI to each downlink carrier." *Id*. However, Mr. Davies fails to point out that this approach would require a sufficiently long preamble to be reserved to account for different CA scenarios. A POSITA would recognize that the transmission of such preamble would be undesirable to wireless operators, as it would require even more bandwidth resources. Therefore, a "preamble" scheme would not have been considered as an alternative to the '192 patent application by a POSITA.

d) "LOOK-UP TABLE" IS NOT AN ALTERNATIVE

41. Without providing specifics, Mr. Davies suggested a look-up table as an alternative to the claimed sorting step.

> A person of ordinary skill in the art would have known that a plausible alternative to sorting each piece of UCI according to a preset sorting rule to decipher which piece of UCI was associated with which downlink carrier, would be to have a base station reference a look-up table to decipher the relationship of each piece of UCI to each downlink carrier.

Id. at ¶ 49.

42. Mr. Davies fails to explain how such a look-up table is not a sorting rule. In fact, to a person of ordinary skill in the art, a look-up table must be shared and pre-determined between the UE and the eNB. Such agreement is, in fact, a sorting rule as disclosed by the '192 Patent Application. To the extent that Mr. Davies argues that such look-up table may be transmitted by the eNB to the UE, a person of ordinary skill in the art would recognize that a look-up table must be sufficiently large to accommodate various cases of carrier aggregation and different types of UCI joint code, and that transmitting such a look-up table requires additional encoding, modulation, and bandwidth resources, without providing any actual benefit. Therefore, a "look-up table" would not have been considered an alternative to the '192 Patent Application by a POSITA.

e) "STOP MESSAGE" IS NOT AN ALTERNATIVE

43. Mr. Davies suggests that instead of letting the eNB calculate the total length of UCI in terms of coded bits, an alternative to,

> establishing a common understanding of the length of UCI after channel coding between the user equipment and the base station would have been to affix a stop message at the end of the jointly channel coded UCI. The stop message methodology has many benefits. For one, it would obviate the need of the base

station and the user equipment to calculate the number of bits of UCI after channel coding.

Id. at ¶ 50.

44. A POSITA would have recognized that a "stop message" must be unique and must be encoded to be identifiable to the receiving eNB. A POSITA would have recognized that encoding an additional stop message would increase the length of the jointly coded UCI, thereby consuming additional bandwidth resources in the uplink. Furthermore, a POSITA would have recognized that adding a stop message to the end of jointly coded UCI is not compatible with the pre-existing UCI channel code for single carrier downlink. A POSITA would have recognized that this lack of compatibility would increase the complexity of UE encoder and eNB receiver. Therefore, a "stop message" would not have been considered an alternative to the '192 Patent Application by a POSITA.

f) THE PATENTS MR. DAVIES IDENTIFIED ARE NOT ALTERNATIVES

1) US20110242997A1 APPLICATION ('997) IS NOT AN ALTERNATIVE

45. Mr. Davies recites the US20110242997A1 Patent Application Publication ("the '997 Patent Application"), *Extended uplink control information (UCI) reporting via the physical uplink control channel (PUCCH)*, with a priority date of April 2, 2010 as an alternative to the '192 Patent Application. The '997 Patent Application relates to the encoding and transmission of the extended UCI. According to Mr. Davies, the '997 Patent Application "discloses the use of bits at the beginning of the UCI message, these bits correspond to a symbol. The symbol is then used [to] encode the UCI, which can then be sent to the base station, and the base station could use the symbol to decode the UCI message." *Id*. at ¶ 51.

46. A POSITA would have recognized that the '997 Patent Application does not disclose an alternative to the '192 invention. In fact, the '997 Patent Application would still require the steps of the invention as shown in the representative Claim 1 of the '192 Patent Application. Specifically, claim 1 of the '997 Patent Application discloses

> Claim 1: A method for reporting uplink control information (UCI), comprising:
>
> encoding a first part of the UCI in a single physical uplink control channel (PUCCH) symbol;
>
> selecting a channel of the PUCCH symbol to implicitly encode a second part of the UCI in the PUCCH symbol; and
>
> transmitting the PUCCH symbol via a single PUCCH signal.

'997 Patent Application at 8.

47. A POSITA would recognize that this claim of the '997 Patent Application relates only to one element of the claims of the '192 Patent Application. Claim 1 of the '997 Patent Application requires encoding a first part and a second part (i.e. extended UCI) in the PUCCH symbol and transmitting the PUCCH symbol via a single PUCCH signal. A POSITA would recognize that Claim 1 of the '997 Patent Application relates only to claimed element (e) of the '192 Patent Application for "transmitting, by the UE, the sorted X pieces of UCI to a base station in the first uplink subframe."

48. A POSITA would have recognized that the invention of the '997 Patent Application does not address the encoding and decoding of multiple UCI pieces corresponding to the multiple activate downlink carrier in CA scenario. As recognized in Mr. Davies' report, a number of coded UCI bits for implicit transmission may be determined using channel selection.

> "Paragraph [0015]: The PUCCH symbol may be configured for uplink signaling. A number of coded UCI bits for *implicit transmission* may be determined using channel selection. Selecting a channel of the PUCCH symbol may include generating a first bit or the first bit and a second bit of the coded UCI bits using a table. The first bit or the first bit and the second bit may be transmitted in the PUCCH symbol.

Davies Rep. at ¶ 53 (citing '997 Patent Application at ¶ 15) (emphasis added).

49. A POSITA would have understood that the eNB may use the channel selection bits encoded in the first PUCCH symbol to indicate the number of extended UCI symbols (2nd part) that may follow. However, the number of extended UCI symbols does not describe how individual UCI for each of the activated downlink carriers are encoded.

50. Based on at least the reasons stated above, a POSITA would also have recognized that the '997 Patent Application does not address the steps a)-d) of the representative Claim 1 in the '192 Patent Application. Therefore, a POSITA would not have considered the '997 Patent Application as an alternative to the '192 Patent Application.

5. CN102282819A PATENT APPLICATION ('819) IS NOT AN ALTERNATIVE

51. Mr. Davies' points to the CN102282819A Patent Application ("the '819 Patent Application"), *Multi-carrier wireless communication system and a transmission method of an uplink control information link means*, with a priority date of January 13, 2009, as providing an alternative.

52. However, as Mr. Davies admits,

> Claim 6 puts forth an approach of delivering UCI messages which allows for the messages to be segmented and delivered over a plurality of channels, rather than on

> a single channel. This differs from the '192 Patent Application in that rather than delivering the UCI in a single channel and associating the UCI for each carrier by ordering, the UCI corresponding to each carrier is based on the channel used to deliver the UCI for each carrier.

Davies Rep. at ¶55.

53. A POSITA would have understood that transmitting UCI "over a plurality of channels" would not only be wasteful because of the inefficient use of more channel bandwidth from multiple component carriers, but often infeasible.

> In LTE-A, the number of downlink 108 carriers may be asymmetric from the number of uplink 106 carriers. Thus, the number of uplink 106 component carriers (CC) may not be the same as the number of downlink 108 component carriers (CC). Directly mapping of an uplink 106 component carrier (CC) and downlink 108 component carrier (CC) is not possible.

'997 Patent Application at [0033].

54. Based on at least the reasons stated above, a POSITA would have recognized that the '819 Patent Application cannot be a viable alternative to the '192 Patent Application.

B. U.S. PATENT APPLICATION PUBLICATION NO. 2009/0303956 A1

1. SUMMARY OF THE '956 PATENT APPLICATION

55. U.S. Patent Application Publication No. 2009/0303956 A1 (the '956 Patent Application), *Method, device and system for assigning ACK channels to users,* with a priority date of April 29, 2008, granted as US Patent No. 8,243,669, was the U.S. counterpart to CN201110264130. The '956 Patent Application provides a method and a system, in TDD LTE mode, for establishing multiple acknowledge (ACK) channels corresponding with a plurality of

downlink subframes on one uplink subframe to be used by a UE to transmit its feedback signal. This is a unique condition for multiple configurations in TDD mode. Furthermore, setting up multiple ACK feedback channels on a single uplink subframe can also free up resources and improve spectral efficiency of wireless networks in general.

56. More specifically, in the TDD mode of LTE that is configured with 5ms switch point periodicity, each radio frame of 10ms is divided into two half-frames that are 5 ms each. Each half-frame consists of eight slots that are respectively 0.5 ms long and contain three special fields, DwPTS, GP, and UpPTS. Every two slots form one subframe, and the three special fields, DwPTS, GP, and UpPTS form a special subframe. Among the subframes, subframes 0 and 5 are for downlink, subframe 2 is an uplink subframe, subframe 1 is a special subframe, subframe 6 may be configured as either downlink or special subframe, and the remaining 5 subframes may be configured as either uplink or downlink, as shown in Table 4.2-2 in section 4.2 of 3GPP TS 36.211 v14.2.0. The ratio of downlink to uplink subframes can flexibly be configured to meet data service needs. There are 7 configurations of different downlink to uplink subframe ration, among which, except the two ratios of 1-to-3 in 5 ms switch periodicity (i.e. uplink-downlink configuration 0) and 3-to-5 in 10 ms switch periodicity (i.e. uplink-downlink configuration 0), all other ratios are required to provide feedback ACK channels for multiple downlink subframes in one uplink subframe. For example, according to Table 10.1.3.1-1 of 3GPP TS 36.213 V14.2.0, in configuration 2, each uplink subframe is responsible for feeding back ACK/NACK information for up to 3 downlink subframes involving multiple scheduled UEs. .

57. The ‘956 Patent Application inventors provided a new method for supporting ACK/NACK feedback on physical uplink control channel (PUCCH) corresponding to more than one downlink subframe on a single uplink subframe for TDD-mode LTE networks. The invention

consists of a method or a system for assigning ACK channels to a UE to feed back ACKs of N downlink subframes in one uplink subframe. The method establishes a linkage relationship between uplink ACK channel index in one uplink subframe and index of control channel elements in multiple downlink subframes. The method includes the following steps.

> Firstly, reserved ACK channels are divided into N blocks; each downlink sub-frame is assigned with a mapping label d, in which each mapping label corresponds to one block; and each block is divided into a plurality of sub-blocks, and each sub-block is assigned with a sub-block label m. Then, the ACK channels are assigned to the downlink sub-frames according to a sequence of increasing the mapping label d first and then increasing the sub-block label m.

'956 Patent Application at ¶¶ [0015]-[0016]. A representative claim (Claim 1) of '956 is reproduced here:

> *1. A method for assigning ACK channels to a user, which is used to feed back ACKs of N downlink sub-frames in one uplink sub-frame, the method comprising:*
>
> *dividing reserved ACK channels into N blocks:*
>
> *assigning each downlink sub-frame with a mapping label d, each mapping label corresponding to one block;*
>
> *dividing each block into a plurality of sub-blocks, each sub-block being assigned with a sub-block label m; and*
>
> *assigning the ACK channels to the downlink sub-frames according to a sequence of increasing the mapping label d first and then increasing the sub-block label m;*

the N being a positive integer.

2. KEY ELEMENTS OF THE '956 INVENTION

58. The '956 Patent Application explains the practical contribution of the invention to wireless bandwidth savings:

> According to the embodiments of the present invention, the reserved ACK channels are divided into blocks according to the downlink sub-frames, each block is divided into a plurality of sub-blocks, and the CCE sets within the same sub-frame are respectively mapped to different sub-blocks, so as to release unused ACK channel resources as whole blocks to form more RBs for the transmission on other channels, for example, PUSCH transmission. Alternatively, ACK channels are consecutively mapped to each sub-frame among the reserved ACK channels, so as to release unused ACK channel resources as whole blocks, thereby saving the ACK channel resources. Alternatively, a plurality of consecutive CCEs is mapped to one ACK channel, or a plurality of downlink sub-frames is assigned with the same mapping label, so as to reduce the overhead of resource reservation, thereby saving the ACK channel resources.

'956 Patent Application at ¶ [0028].

59. The key aspects of the invention of the '956 Patent Application consist of 4 major elements: (a) a reservation unit for reserving the ACK channels; and an assignment unit for (b) dividing ACK channels into N blocks and assigning each downlink sub-frame with a mapping label d corresponding to one block; (c) further dividing each block into a plurality of sub-blocks, each sub-block being assigned with a sub-block label m; and (d) assigning the ACK channels to

the downlink sub-frames in the order of increasing the mapping label d first and then increasing the sub-block label m.

60. The '956 Patent Application discloses a device for implementing the invention.

> A device for assigning ACK channels to a user provided in one embodiment of the present invention includes a reservation unit and an assignment unit. The reservation unit is configured to reserve ACK channels for N downlink sub-frames. The assignment unit is configured to divide the reserved ACK channels into N blocks; assign each downlink sub-frame with a mapping label d according to a preset rule, in which each mapping label corresponds to one block; divide each block into a plurality of sub-blocks; and assign the ACK channels to the downlink sub-frames according to a sequence of increasing the mapping label d first and then increasing a sub-block label m.

'956 Patent Application at ¶ [0024].

3. ESSENTIALITY OF THE '956 INVENTION

61. Taking advantage of the novelties and the benefits of the invention in the '956 Patent Application, 3GPP has adopted the invention in its 4G-LTE standard. Specifically, Section 10.1.3 of 3GPP TS 36.213 V14.2.0 utilizes the inventions of the '956 Patent Application to specify the TDD HARQ-ACK feedback procedures for UEs in EUTRAN systems. Section 5.4 of 3GPP TS 36.211 v14.2.0 utilizes the invention of the '956 Patent Application to specify the relevant PUCCH formats.

4. PERSON OF ORDINARY SKILL IN THE ART (POSITA) ALTERNATIVES

62. Mr. Davies' report suggests that "[t]here exist many alternatives to the ACK channel allocation scheme presented in the '956 Patent Application, all of which would have been

well understood and deemed plausible by a POSITA at the time of the filing date." Davies Rep. at ¶ 66.

63. Mr. Davies' suggested alternatives include "Extremes", "Symbols", and "Patent Alternatives". *Id*. at ¶¶ 66-76.

a) HINDSIGHT

64. Mr. Davies applied hindsight unavailable to a person of ordinary skill in the art (POSITA) in proposing his so-called "(POSITA) alternatives." Mr. Davies does not identify or rely upon any prior art references, or cite any evidence at all, to support his opinion that a POSITA would have known about these alleged alternatives. Mr. Davies appears to have made up these "(POSITA) alternatives" based on hindsight.

b) "EXTREMES" IS NOT AN ALTERNATIVE

65. Mr. Davies suggests that,

> a plausible alternative channel allocation method would have been to map channels to available sub-frames by alternating between extremes in the time domain. That is, channels would be positioned in time in an alternating fashion between the earliest available position and the latest available position. In this scheme, any channels allocated to a group of frames would exist at the temporal boundaries, leaving all additional free blocks in the temporal center of the group.

Id. at ¶ 67.

A POSITA would not have viewed such a proposal to be an alternative to the invention in '956 Patent Application.

66. A POSITA would have recognized that Mr. Davies' suggested "Extremes" alternative, based on hindsight, only addresses the reservation of ACK channels in the uplink

subframe, i.e., it only addresses element (a) of the representative claim. The suggested "Extreme" channel assignment does not address elements (b)-(d) of the representative claims. A POSITA would have understood that, without dividing the downlink ACK channels into N blocks with block labels, and further dividing each block into a plurality of sub-blocks with sub-block labels, the suggested alternative does not address the key objective of using one uplink subframe to carry multiple ACK channels for the downlink frames.

67. Mr. Davies further suggests that the "extremes" alternative could be used for, allocating the necessary channels in a particular order. For example, the channels to be mapped to the available network resources could first be ranked according to their CCE length. The channel demanding the most network resources would be allocated first, at the earliest position. Next, the shortest channel would be allocated at the last possible position. The second-most resource-intensive channel would be allocated next and be placed directly after the first channel, at the earliest position available. The second-shortest channel would be allocated next in the latest available position, and so on. Once again, any free resources will be pooled between the earliest and latest blocks of channels. Additionally, this temporal distribution of channels according to size will increase the probability that any given channel release will result in the clearing of usable blocks. The free resource pool initially restricted to the temporal center will be adjacent to the two channels closest to the median channel CCE length. Assuming for example the probability of any given channel release being equal, this configuration increases the expected value of the number of frames, and therefore resource blocks, that will be formed in contiguity to the central pool of free network resources upon any given release. This allocation

> scheme essentially tries to pool as many free resources as possible up-front and hedges against fragmentation risk by separating the most resource-intensive channels from the least resource-intensive channels in the time domain.

Id.

68. A POSITA would have recognized that Mr. Davies' suggested "extremes" method is not an alternative since it fails to consider the practical constraints imposed by real-world wireless communication networks like LTE TDD, and is meaningless at least for the following reasons.

69. For example, in LTE TDD, the number of downlink subframes that are required to feedback ACK/NACK information on a same uplink subframe, is determined by the uplink-downlink configuration, as specified in Table 10.1.3.1-1 of 3GPP TS 36.213 v14.2.0. For this reason, Mr. Davies' assertion that "[a]ssuming for example the probability of any given channel release being equal, this configuration increases the expected value of the number of frames" (*Id*.) is a meaningless hypothetical that is far from reality.

70. Similarly, Mr. Davies ignored practical LTE system constraints by suggesting to rank ACK channels according to their CCE length. "For example, the channels to be mapped to the available network resources could first be ranked according to their CCE length. The channel demanding the most network resources would be allocated first, at the earliest position. Next, the shortest channel would be allocated at the last position." *Id*. However, the uplink ACK channels of PUCCH format 1a/1b are of equal size in LTE, corresponding to 1/18 of a RB. Hence, it does not make sense to rank ACK channels according to their length. Furthermore, CCE is used to construct physical downlink control channel (PDCCH) and has fixed size. It would have been well

known to a POSITA that CCE is not used to construct uplink ACK channel. Mr. Davies' suggestion confuses the CCE in PDCCH with the RB of the PUCCH and is practically meaningless.

71. A POSITA would have understood that the claim element (d) of the '956 Patent Application for assigning the ACK channels to the downlink sub-frames in the order of increasing the mapping label d first and then increasing the sub-block label m would offer substantial signaling simplicity and bandwidth savings when the network side device consisting of a reservation unit and an assignment unit assigns ACK channels to a UE in connected state. To the extent that Mr. Davies' argues his suggestion of channel ranking according to their CCE length was meant to suggest channel ranking according to their resource lengths, a POSITA would have recognized that the suggested allocation to the extremes based on the required resource lengths would require more complex assignment signaling and consume more control channel bandwidth, particularly when a large number of UEs are being served by the network. For at least these reasons, Mr. Davies' "extremes" method would not have been considered an acceptable alternative by a POSITA.

c) "SYMBOLS" IS NOT AN ALTERNATIVE

72. Mr. Davies suggested that "multiple ACK/NACK messages related to downlink sub-frames could be combined and sent on a single uplink channel if the control information is placed in a single data stream and then multiplexed with a user data stream using a modulation scheme such as phase-shift keying." *Id*. at ¶ 69.

73. The '956 Patent Application focuses on allocating uplink ACK channels corresponding to multiple downlink sub-frames on a single uplink sub-frame. What modulation scheme to use for transmitting ACK/NACK information on the allocated uplink ACK channels is another issue. A POSITA would have recognized that modulating and encoding ACK/NACK

information can directly be applied when transmitting ACK/NACK information on the uplink ACK channels based on the invention of the '956 Patent Application. Section 5.2.3 of 3GPP standard TS 36.212 clearly discloses such encoding ("Each positive acknowledgement (ACK) is encoded as a binary '1' and each negative acknowledgement (NACK) is encoded as a binary '0'."). Specifically, Table 5.4-1 of 3GPP standard TS 36.211 v14.2.0 illustrates a plurality of supported PUCCH formats, in which every format supports a phase-shift keying. In particular, format 1a applies binary phase-shift keying (BPSK) modulation whereas format 1b, format 2, format 3 all apply quadrature phase-shift keying (QPSK) modulation. Section 7.1.1 and Section 7.1.2 of 3GPP standard TS 36.211 v14.2.0 discloses modulation for BPSK and QPSK respectively. A POSITA would have understood that since the '956 Patent Application relates to the transmission of PUCCH, the ACK channels must be transmitted by using phase-shift keying modulation even though the '956 does not explicitly explain modulation to be phase-shift-keying. For this reason, use of "symbols" as described by Mr. Davies does not represent an alternative solution of the invention of the '956 Patent Application.

74. Mr. Davies appears to suggest that multiple ACK channels corresponding to the multiple downlink subframes be combined into a single message stream and jointly transmitted with a user payload stream.

> [T]he control information is placed in a single data stream and then multiplexed with a user data stream using a modulation scheme such as phase-shift keying. In such a system, individual bits of control information and user data can be combined and simplified into symbols, also sometimes called constellations, that encode information from two separate data streams.

Davies Rep. at ¶ 69.

Uplink transmission of multiplexed ACK channels with UE payload would require scheduled PUSCH for payload uplink. Particularly, in the cases when the UE has no payload to transmit or has not received PUSCH scheduling, then the UE ACK feedback would have to rely on PUCCH. The '956 Patent Application specifically addresses the problem of ACK channel transmission on PUCCH. Thus, a POSITA would have recognized that this "symbols" method is not an alternative.

75. Furthermore, to the extent that Mr. Davies suggests that multiple ACK/NACK messages should be combined and jointly modulated into symbols using a large constellation which has to be jointly received and decoded, a POSITA would have recognized that with as many as 8 downlink subframes, the erroneous reception by the eNB of the jointly encoded ACK/NACK messages would lead to the ACK/NACK errors of all the downlink subframes. Such a PUCCH transmission error would require the retransmission of all the data blocks in the downlink subframes whose ACK channels are multiplexed. A POSITA would have recognized that such ACK encoding would lead to substantial increase of spectral resources for downlink data block retransmission.

76. Mr. Davies further asserts that

> binary phase-shift keying (BPSK) allows twice as much data to be transmitted per symbol as [sic] would be transmitted on a normal, unmodulated channel . . . Combining ACK/NACK transmissions with user data and phase-shift key modulating the allocated resulting channel succeeds in improving network resource utilization and efficiency, albeit in a very different way than the method of the '956 Patent Application.

Id. at ¶ 69.

First, this statement discusses different ways to modulate data signals for transmission but does not address the invention of the '956 Patent Application which focuses on supporting ACK/NACK feedback corresponding to more than one downlink subframe on a single uplink subframe for TDD-mode LTE networks. First, a "normal, unmodulated channel" cannot carry payload data. It is therefore meaningless to compare BPSK modulation with an unmodulated channel. Second, as explained earlier, Table 5.4-1 of 3GPP standard TS 36.211 v14.2.0 illustrates a plurality of supported PUCCH formats, each supporting a phase-shift keying. In particular, format 1a applies binary phase-shift keying (BPSK) modulation whereas format 1b, format 2, format 3 all apply quadrature phase-shift keying (QPSK) modulation. A POSITA would have understood that since the '956 Patent Application relates to the transmission of PUCCH, the ACK channels must be transmitted by using phase-shift keying modulation even though the '956 Patent Application does not explicitly explain modulation to be phase-shift-keying.

77. Based on at least the reasons stated above, a POSITA would not have considered "symbols" to be an alternative to the invention of the '956 Patent Application.

d) THE PATENTS MR. DAVIES IDENTIFIED ARE NOT ALTERNATIVES

1) US 2010/0322114 A1 ('114) IS NOT AN ALTERNATIVE

78. The Davies report proposes as an alternative US 2010/0322114 A1 Patent Application Publication ("the '114 Patent Application"), *Method for allocating uplink ACK/NACK channels*, with priority date of Feb. 4, 2008. The '114 Patent Application provides a method for allocating uplink ACK/NACK channels for downlink data transmission in a wireless communication system.

79. According to one aspect of its invention, a method for binding CCE and ACK/NACK in a downlink sub-frame is provided. The specific steps of the '114 Patent Application involve multiple downlink subframes:

> According to another aspect of present invention, a method for impliedly binding CCE and ACK/NACK in a plurality of downlink sub-frames comprising steps of:
>
> a) a Node B transmitting downlink physical control channels and downlink data in the plurality of downlink sub-frames respectively;
>
> b) a UE detecting THE downlink physical control channels in the plurality of sub-frames and receiving the downlink data transmitted from the node B accordingly;
>
> c) UE obtaining indexes of ACK/NACK channel in an uplink sub-frame based on a minimum CCE index of the downlink physical control channels and the indexes of downlink sub-frames occupied for downlink data transmission, and transmitting ACK/NACK signals;
>
> d) the Node B receiving ACK/NACK channels of uplink sub-frame and detecting ACK/NACK information of downlink data scheduled in each downlink sub-frame.

'114 Patent Application at ¶¶ [22]-[26].

80. A POSITA would have recognized that, unlike the invention of the '956 Patent Applications, the key steps of the '114 Patent Application are for the UE to detect the downlink physical control channels in the plurality of subframes and to obtain the indices of the ACK/NACK channel in an uplink subframe based on a minimum CCE index of the downlink physical control

channels and the indices of downlink subframes occupied for downlink data transmission, and transmitting ACK/NACK signals.

81. More specifically, the '114 Patent Application does not address any one of the elements (a)-(d) disclosed in the invention of the '956 Patent Applications. The '114 Patent Application discloses neither a reservation unit for reserving the ACK channels, nor an assignment unit for reserving the ACK channels dividing ACK channels into N blocks and assigning each downlink sub-frame with a mapping label d corresponding to one block; further dividing each block into a plurality of sub-blocks, each sub-block being assigned with a sub-block label m; and assigning the ACK channels to the downlink sub-frames in the order of increasing the mapping label d first and then increasing the sub-block label m.

82. Based on at least the reasons stated above, a POSITA would not have viewed the '114 Patent Application as an alternative method.

2) US 2009/0285122 A1 ('122) IS NOT AN ALTERNATIVE

83. The Davies report proposes as an alternative US 2009/0285122 A1 Patent Application Publication ("the '122 Patent Application"), *Uplink control for time-division duplex with asymmetric assignment,* with priority date of April 21, 2008. The '122 Patent Application proposes "a hybrid bundling module configured to provide a hybrid ACK/NAK bundling structure for an uplink ACK/NAK entity from user equipment, wherein the hybrid ACK/NAK bundling structure corresponds to an uplink-downlink configuration of subframe assignments." '122 Patent Application at ¶ [0005].

84. The '956 Patent Application deals with the problem to allocate uplink ACK channels corresponding to multiple downlink sub-frames on a single uplink sub-frame over PUCCH. How to transmit the ACK/NACK information on the allocated uplink ACK channels is

another question. There existed at least two transmission schemes that are compatible with the '956 Patent Application for ACK/NACK transmission on the allocated uplink ACK channels: HARQ-ACK bundling and HARQ-ACK multiplexing. The '122 Patent Application discusses how to transmit ACK/NACK information on the allocated uplink ACK channels, by bundling multiple ACK/NACK bits into a bundled ACK/NACK bit through a logical AND operation. A POSITA would have recognized that this method of hybrid ACK/NACK bundling is a different design component for feeding back multiple ACK/NACK information in assigned uplink ACK channel and, therefore, is not an alternative to the '956 Patent Application.

85. A POSITA would also have recognized that hybrid ACK/NACK bundling disclosed in the '112 Patent Application is a well known practice in the prior art. In particular, documents R1-080870 and R1-081110 in 3GPP TSG RAN WG1 meeting #52 (Feb. 11-15, 2008) explicitly describe the process of ACK/NACK bundling which combines multiple ACK/NACK for transmission in a single ACK channel. A POSITA would have recognized that, unlike the process of ACK/NACK multiplexing in an uplink subframe, which contains multiple ACK/NACK feedback channels and is also disclosed in R1-081110, ACK/NACK bundling is not an alternative technology and is used when reporting ACK/NACK of multiple data blocks or subframes under limited PUCCH resources. A POSITA would have recognized that by bundling ACK/NACK messages of multiple downlink subframes, erroneous reception by the eNB of bundled ACK/NACK message would lead to the reception errors of ACK/NACK messages for all the downlink subframes. Such a PUCCH transmission error would compel the retransmission of all the data blocks in the downlink subframes involved in the bundling even if only one data block within the bundled downlink subframes is received erroneously. This is because the eNB would not have been able to distinguish which ones of the bundled data blocks are correctly received. As

explained in R1-080870, an ACK is generated only if all assigned DL subframes are received correctly, whereas a NACK is generated otherwise.

> For simplicity, let us consider the single code block case in which a single ACK/NACK is generated for each DL subframe and that PUCCH formats carrying a single ACK/NACK bit are used. The idea with bundling is then to generate a single ACK/NACK report based on the ACK/NACKs of the assigned subframes. A simple rule is to generate an ACK only if all assigned DL subframes are received correctly, whereas a NACK is generated otherwise.

R1-080870 at 1.

86. A POSITA would have recognized that ACK encoding according to the '122 Patent Application would lead to a substantial increase of required spectral resources for downlink data block retransmission. The growth of required spectral resources used for downlink data block retransmission to remedy possible packet loss means the corresponding loss of spectral efficiency. Because a primary goal of wireless design is to make efficient use of spectral resources for data transmission, a POSITA would not have viewed ACK/NACK bundling as a viable alternative to the '956 Patent Application.

87. Based on at least the reasons stated above, a POSITA would have recognized that the '122 Patent Application does not provide an alternative to the invention of the '956 Patent Application.

3) KR20080096351A IS NOT AN ALTERNATIVE

88. The Davies' report proposes as an alternative KR20080096351A Patent Application Publication ("the '351 Patent Application"), *A method for transmitting control channel in a communication system*, with priority date of April 27, 2007. The '351 Patent

Application discloses a method for transmitting a control channel in a communication system by mapping a virtual resource to a physical resource and using a block interleaver. As Davis' report suggests, according to the '351 Patent Application, "individual control channel elements (CCEs) are grouped and then permuted within the group to conform to a predetermined pattern by an interleaver. The permuted CCEs are then mapped to the physical resource (or channel) and this mapped control channel is transmitted." Davies Rep. at ¶ 75.

89. The '351 Patent Application does not target the problem of transmitting multiple ACK channels corresponding to multiple downlink subframes in an uplink subframe of TDD mode. By its own terms, the '351 Patent Application addresses the transmission of a control channel for cellular communication in a multicell environment: "This document relates to a method of transmitting a control channel in a communication system in a communication system to more specifically relates to a communication system and a multiple-cell environment, by using the cell specific information." '351 Patent Application at Description.

90. A POSITA would have recognized that the '351 Patent Application considers a different problem from that of the '956 Patent Application. Specifically, the '351 Patent Application does not disclose the reservation unit for (a) reserving ACK channels, the assignment unit for (b) dividing ACK channels into N blocks and assigning each downlink sub-frame with a mapping label d corresponding to one block, (c) further dividing each block into a plurality of sub-blocks, each sub-block being assigned with a sub-block label m, and (d) assigning the ACK channels to the downlink sub-frames in the order of increasing the mapping label d first and then increasing the sub-block label m.

91. The cited portions by Mr. Davies from the '351 Patent Application are only related to the mapping of control channel elements (CCEs) to the physical resources in downlink, which

are not relevant to the problem of the '956 Patent Application which focuses on allocating ACK channels corresponding to multiple downlink subframes on a single uplink subframe. A POSITA would not have recognized any cited portions by Mr. Davies to be related to the '956 invention.

92. Based on at least the reasons stated above, a POSITA would have recognized that the '351 Patent Application does not provide an alternative to the invention of the '956 Patent Application.

C. CHINESE PATENT NO. CN100571106C ('106)

1. SUMMARY OF THE '106 PATENT

93. Chinese Patent No. CN100571106C, *Wireless Network Communication Device*, (the '106 Patent) with priority date of March 22, 2006, was issued from CN200610058405. The '106 Patent provides "a new wireless network communication device in response to the newly proposed AM and UM entities of the EUTRAN system to support functions not supported in Release 6 protocol to improve system performance." '106 Patent at 4.

94. In the EUTRAN architecture, the conventional radio interface protocol is shown in Figure 2 (reproduced below), wherein the radio interface protocol is divided into three layers: the physical layer (L1), a data link layer (L2), a network layer (L3). L2 comprises the following sublayers: media access control (MAC), Radio Link Control (RLC), Packet Data Convergence Protocol (PDCP), and broadcast / multicast control protocol (BMC). In general, RLC layer supports three types of operations, a transparent mode (TM) service, unacknowledged mode (UM) service, and an acknowledged mode (AM) service.

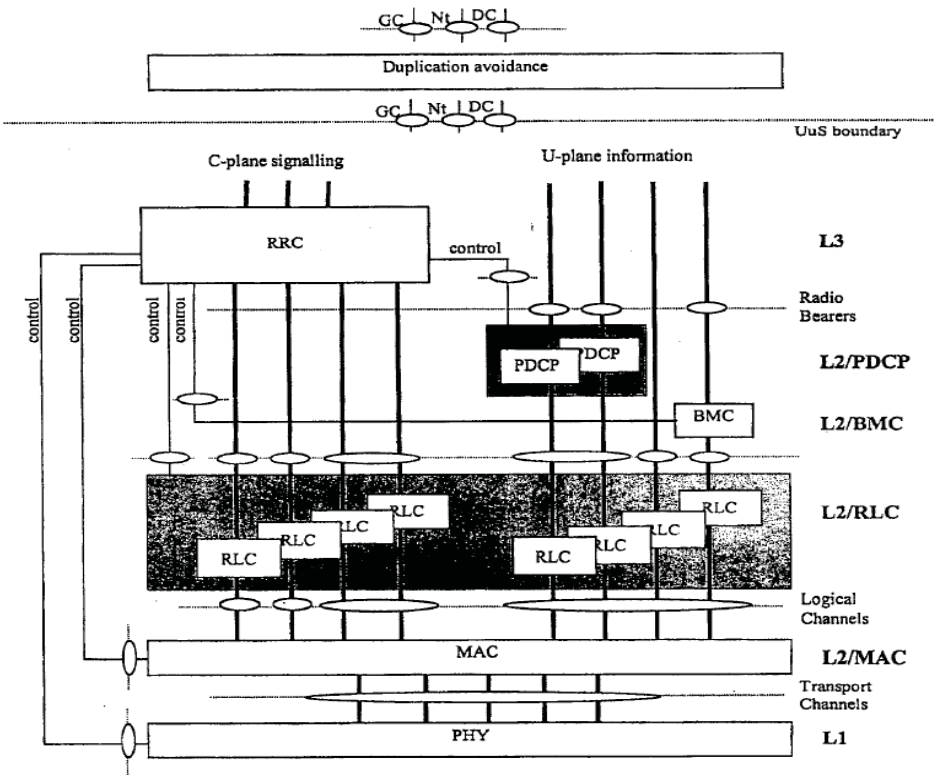

Figure 2 (the '106 Patent)

95. The '106 Patent invention discloses

a wireless network communication device comprising at least one type of upper layer automatic retransmission request (ARQ) entity; said upper layer ARQ being an acknowledged mode ARQ entity; said ARQ entity further having a transmitting part and a receiving part; said transmitting part further comprising segmentation-concatenation element for data unit segmentation/concatenation, retransmission buffer element for buffering protocol data units after segmentation/concatenation and for processing the buffered protocol data units; said receiving part further comprising: a reordering element for sorting received protocol data units; reassembly element for reassembling sorted protocol data units (PDUs) into service data units (SDUs) for submitting to upper layers;

wherein said step of segmentation/concatenation of data units includes repeating segmentation/concatenation process on retransmission data units at the input of the segmentation concatenation element and adding respective data header information.

'106 Patent at 4-5.

Figure 6 describes the ARQ entities at the transmitter and the receiving sides (reproduced below):

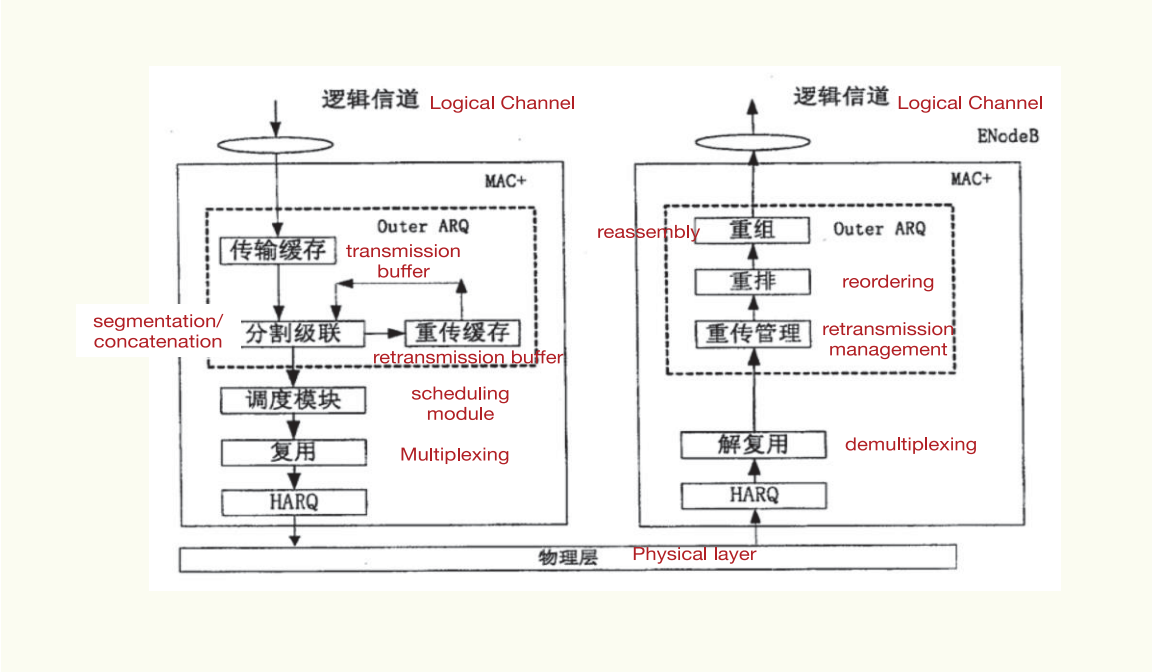

Figure 6 (the '106 Patent)

96. A representative independent claim (Claim 1) of the '106 Patent is reproduced here:

1. A radio communication network apparatus, comprising

(a) at least one upper layer ARQ entity;

(b) wherein said upper layer ARQ entity is an acknowledged mode (AM) ARQ entity, the AM ARQ entity having a transmitting part and a receiving part;

(c) said transmitting portion further comprising (c1) segmentation concatenation element for segmentation/concatenation of data unit; (c2) retransmission buffer element for buffering protocol data units (PDUs) after segmentation/concatenation and for processing buffered PDUs;

(d) said receiving portion comprising

(d1) a reordering element for sorting received PDUs;

(d2) reassembly element for reassembling reordered PDUs into SDUs to be delivered to higher layers.

(e) wherein said step of segmentation/concatenation of data units includes repeating the segmentation/concatenation process on retransmission data units at the input of the segmentation/concatenation element and adding respective data header information.

'106 Patent, Claim 1.

2. KEY ELEMENTS OF THE '106 PATENT'S INVENTION

97. The '106 Patent summarizes that "[t]he current Release 6 (R6) standard for UMTS has some weaknesses. Notably, the RLC sublayer resides at the radio network controller (RNC) instead of the base-station (eNB) and the R6 RLC supports both AM and UM based on equal PDU size through segmentation/concatenation. The receiver side support both sequential and out-of-sequence SDU delivery. In R6, AM RLC and UM RLC further established based on service needs." '106 Patent at 6. The inventors of the '106 patent noted that:

Since RNC is removed in EUTRAN, the RLC is moved below to the basestation (eNB) and may either stand alone as an individual layer, or may be combined with

> the MAC layer to form a MAC+ layer, so as to better utilize the transmission efficiency of the radio-interface air interface and reduce padding. Its segmentation/concatenation can be based on flexible PDU sizes. Furthermore, the EUTRAN system's network access is an all-IP architecture, wherein the PDCP layer is located in an access gateway (aGW). Thus, data reception must follow the order of PDCP packet transmission sequence, in order to reduce errors for the header compression in PDCP, while sequential SDU delivery by the RLC alone can no longer guarantee sequential reception by the PDCP layer. For these reasons, the characteristics of the AM and UM entities in the RLC layer of R6 can no longer meet the needs of the EUTRAN system.

See '106 Patent at 8.

98. The '106 Patent proposes a new AM entity for 3GPP EUTRAN networks. A POSITA would have been able to use its first embodiment as an example. Specifically,

> The transmitting section of the AM entity at the base-station comprises: (a) a transmission buffer element, for buffering service data units (SDUs) from a logical channel; (b) a segmentation concatenation element for segmenting or concatenating SDUs in the transmission buffer to generate PDUs; (c) a retransmission buffer element to buffer segmented/concatenated PDUs for retransmission. The outer ARQ entity sends the resulting PDUs to the MAC within the station, and the station MAC scheduler schedules the PDUs to be multiplexed. The station MAC communicates with the physical channel through transport channel to implement HARQ retransmission for the multiplexed PDUs.

'106 Patent at 8.

> The receiving part of the AM entity comprises: MAC in the station executes retransmission on the received physical layer PDUs when errors occur and demultiplexes retransmitted PDUs; the MAC within the station sends the demultiplexed PDUs to the retransmission management element for retransmission managing; the reordering element sorts the PDUs after retransmission management; the reassembly element reassembles the sorted PDUs to form SDUs to be sent via a logical channel for delivery to upper layers.

Id.

99. The inventors explicitly described some of the advantageous effects of the '106 invention:

> By setting the transmission buffer to buffer SDUs, SDUs can be flexibly discarded according to data transmission status to improve data transmission efficiency, and can easily forward data during switchover of basestations or UEs;
>
> By setting (default) buffer size threshold in the transmission buffer to control basestation or UE traffic control with the aGW, this invention helps prevent data loss due to basestation or UE congestion. It can also flexibly set buffer size threshold according to different scenarios to help reduce data forwarding amount, thereby avoiding data loss during switchover of basestations or UEs;
>
> By retransmitting each data unit in the retransmission buffer, the invention avoids the retransmission of the entire data block when only partial data fails to be correctly transmitted. Also, based on the configured maximum segmentation number of the data blocks, retransmission buffer may only buffer the maximum segmented data to reduce the complexity of segmentation and reassembly;

By supporting out of sequence SDU delivery, the invention increases the processing speed of the base-station or UE, while making it possible to timely clear the respective buffer;

By pre-configuring QoS attributes of the logical channel, the invention reduces scheduling complexity, and also effectively carrys out multiplexing before HARQ to avoid the performance loss as a result of multiplexing service data of different QoS attributes;

By setting the value of the sequence field based on service attributes or logical channel's QoS attributes, the invention can save the overhead of air interface.

See *Id*.

3. ESSENTIALITY OF THE '106 PATENT'S INVENTION

100. Exploiting its novelties and the advantages, 3GPP has adopted the invention of the '106 Patent in its 4G-LTE standard. Specifically, Section 4.2.1.2 of 3GPP TS36.322 V13.2.0 describes the UM RLC entity. The AM RLC entity is disclosed in Section 4.2.1.3 of 3GPP TS36.322 V13.2.0, and utilizes the '106 invention as is illustrated using the following figure. The retransmission ARQ procedures of the AM RLC entity utilizes the invention of the '106 Patent and is further described in Section 5.2.1 of 3GPP TS 36.322 V13.2.0.

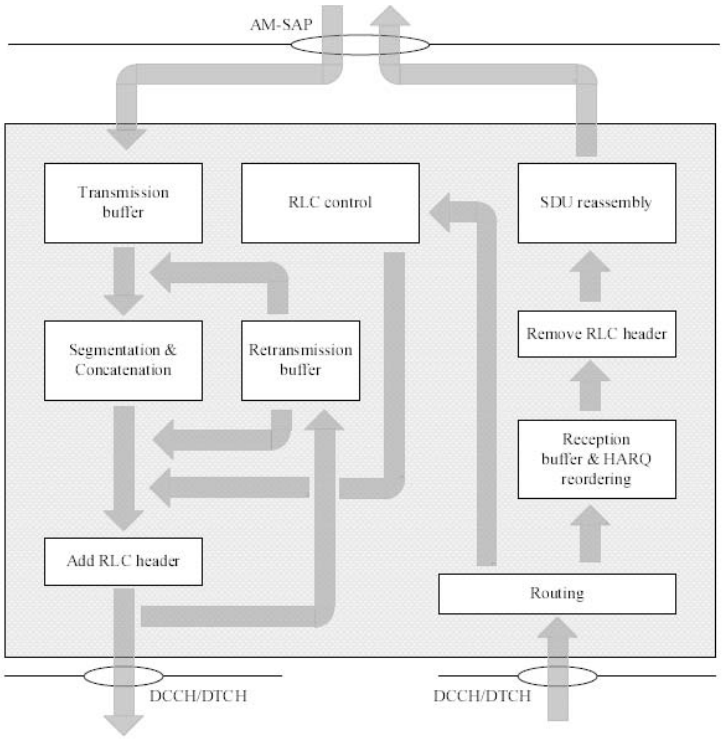

Figure 4.2.1.3.1-1: Model of an acknowledged mode enttiy

3GPP TS 36.322 V13.2.0 at Fig. 4.2.1.3.1-1.

4. PERSON OF ORDINARY SKILL IN THE ART (POSITA) ALTERNATIVES

a) HINDSIGHT

101. Mr. Davies applied hindsight unavailable to a POSITA in proposing his so-called "(POSITA) alternatives." Mr. Davies does not identify or rely upon any prior art references, or cite any evidence at all, to support his opinion that a POSITA would have known about these alleged alternatives. Mr. Davies appears to have arrived at these "(POSITA) alternatives" based purely on hindsight.

b) "SMALL PDUS" IS NOT AN ALTERNATIVE

102. Mr. Davies maintains that, instead of using flexible PDU sizes, an alternative would be to limit "the size of PDUs to very small PDUs, as if the PDUs were sufficiently small they could be segmented and concatenated without any padding, in fact it would be likely that the SDUs

would have to be segmented (broken apart) to fulfill the PDU size requirement." Davies Rep. at ¶ 86.

103. A POSITA at the time of the filing of the '106 Patent would have recognized, as disclosed in the '106 Patent Application, that a major benefit of the cellular network evolution to EUTRAN (4G-LTE) is the substantially improved physical layer transmission rate with the adoption of OFDMA and SC-OFDM technologies. Under good physical channel conditions, the much improved EUTRAN data rates by the physical and transport channels facilitate very efficient data transmission beyond the previous R6 protocol for forming large sized PDU.

104. A POSITA would have recognized that by limiting the use of small PDUs, the high speed data transmission provided by the EUTRAN (4G-LTE) system would not be fully taken advantage of by the RLC. To be clear, "smaller PDUs" is not to improve upon the fixed PDU size of the R6, except to make the PDU size even smaller. A POSTIA would understand that smaller PDU size would reduce the relative amount of PDU payload relative to its header field, thereby further reducing the transmission efficiency of the R6 protocol, instead of improving it.

105. Mr. Davies analogizes the '106 Patent to a man packing his belongings to move to a new apartment, but the rental van company has only one type of vehicle available that is too large. Davies Rep. at ¶¶ 84-85. Mr. Davies acknowledges that the '106 Patent solved such a packing problem, and he argues that using "small PDUs" provides an alternative solution. But "small PDUs" does not. To follow the analogy used by Mr. Davies, the "small PDUs" alternative is like a person always renting a very small-sized vehicle to move his/her belongings, even though the vehicle rental company has a fleet of many different vehicle sizes, all at very low or similar prices, and even though using a small vehicle could take many trips over many days.

106. Furthermore, the suggestion of "smaller PDUs" does not address the acknowledge mode RLC, the retransmission management, retransmission buffer, and the receiver side entity in the invention. In summary, a POSITA would have recognized that the suggestion of using "smaller PDUs" fails to provide alternatives to any of the elements (a)-(e) in the representative claim (Claim 1) of the '106 Patent.

107. Based on at least the reasons stated above, a POSITA would not have found "smaller PDUs" to be an alternative to the inventions disclosed in the '106 Patent.

c) "ORDERING" IS NOT AN ALTERNATIVE

108. Mr. Davies suggests that an alternative to accomplish sequential delivery of SDUs to the PDCP for reducing errors during head decompression is by "having a MAC layer schedule its PDU transmissions according to the exact order." Davies Rep. at ¶ 87.

109. A POSITA, however, would have recognized that "ordering" by the MAC layer is not a viable alternative in AM RLC because of the need for PDU acknowledgement in the AM mode to ensure that lost PDUs can be retransmitted and received. Mr. Davies' suggestion of "having a MAC layer schedule its PDU transmission according to the exact order" cannot be accomplished because of the inevitable packet losses during the wireless transmission at the physical layer. Davies Rep. at ¶ 87. A POSITA would have recognized that, in order to achieve successful reception of the PDUs, retransmission by the transmitter side is necessary to retransmit the lost PDUs buffered in the retransmission buffer, thereby leading to out-of-sequence PDU receptions.

110. Specifically, the '106 Patent explicitly stated the following advantages of the invention:

By setting the transmission buffer to buffer SDUs, SDUs can be flexibly discarded according to data transmission status to improve data transmission efficiency, and can easily forward data during switchover of basestations or UEs;

By setting (default) buffer size threshold in the transmission buffer to control basestation or UE traffic control with the aGW, this invention helps prevent data loss due to basestation or UE congestion. It can also flexibly set buffer size threshold according to different scenarios to help reduce data forwarding amount, thereby avoiding data loss during switchover of basestations or UEs;

By retransmitting each data unit in the retransmission buffer, the invention avoids the retransmission of the entire data block when only partial data fails to be correctly transmitted. Also, based on the configured maximum segmentation number of the data blocks, retransmission buffer may only buffer the maximum segmented data to reduce the complexity of segmentation and reassembly;

By supporting out of sequence SDU delivery, the invention increases the processing speed of the base-station or UE, while making it possible to timely clear the respective buffer;

By pre-configuring QoS attributes of the logical channel, the invention reduces scheduling complexity, and also effectively carrys out multiplexing before HARQ to avoid the performance loss as a result of multiplexing service data of different QoS attributes;

By setting the value of the sequence field based on service attributes or logical channel's QoS attributes, the invention can save the overhead of air interface.

See '106 Patent at 6.

111. A POSITA would have recognized that the suggestion of "ordering" does not provide any of the above advantages presented by the '106 Patent.

112. Furthermore, the suggestion of "ordering" fails to address the acknowledge mode RLC, the retransmission management, retransmission buffer, and the receiver side entity in the invention disclosed in the '106 Patent. In summary, a POSITA would have recognized that the suggestion of using "ordering" fails to provide alternatives to any of the elements (a)-(e) in the representative claim (Claim 1) of the '106 Patent.

113. Based on at least the reasons stated above, a POSITA would not have found "ordering" to be an alternative to the inventions disclosed in the '106 Patent.

II. TECHNICAL COMPARISON BETWEEN UNWIRED PLANET PATENTS AND ASSERTED HUAWEI AND SAMSUNG PATENTS

114. I have been asked to opine on the technical comparability of five Unwired Planet patents (EP2229744, EP2119287, EP2485514, EP1230818, EP1105991) (collectively, "Unwired Planet Patents"), the six Huawei patents asserted in this case (U.S. Patent Nos. 8,416,892; 8,483,166; 8,644,239; 8,885,587; 8,412,197; and 8,724,613) (collectively, "Huawei Patents"), and the six Samsung patents asserted in this case (U.S. Patent Nos. RE44105; 8,619,726; 8,761,130; 8,509,350; 9,288,825; 9,113,419) (collectively, "Samsung Patents").

115. Upon review of these patents and publicly available information about them, I have found that the Unwired Planet patents are substantially different from the Huawei Patents from a technical perspective.

A. UNWIRED PLANET PATENTS

1. EP2229744

116. EP2229744 was issued to Janne Peisa, Michael Meyer, and Johan Torsner with a priority date of 2008-01-08. It belongs to a family of patents declared by the patent holder to be likely essential to TS36.322 according to the ETSI database. EP2229744 discloses a method of radio link control (RLC) polling with which a transmitting node in a communication network requests status reporting from a receiving node such that the sending node can be informed which data, if lost, should be resent. The EP2229744 Patent suggests that the RLC polling for receiver status reporting be triggered by counting the number of transmitted data units and the number of transmitted data bytes of the transmitted data units.

117. The relevant technical specification Section 5.2.2 of 3GPP TS 36.322 describes acknowledge mode (AM) RLC polling for status-reporting in the ARQ procedure. However, the disclosed technology is a counter-based trigger to send polling message for status reporting to a receiver node. By focusing on the trigger for transmitting polling message, the level of innovation for this disclosed technology is quite low. A POSITA would have recognized that there exist many alternatives such as polling triggers by a timer, transmitter buffer or channel quality.

2. EP2119287

118. EP 2119287 was issued to Johan Moe and Harald Kallin with a priority date of 2007-02-28. It belongs to a family of patents declared by the patent holder to be likely essential to 3GPP Technical Specification 3GPP TS 36.331 (4G-LTE) according to the ETSI database. The patent discloses a method for a mobile UE in a multi-cell wireless telecommunications system to receive an instruction from the BS of a first cell to detect a unique cell identifier information for a second cell upon receipt of the instruction, and report the detected unique cell identifier information for the second cell to the BS of the first communications cell.

119. The relevant technical specification Section 5.5 of 3GPP TS 36.331 describes the Intra-LTE/frequency Automatic Neighbour Relation (ANR) function of the eNB in the serving cell. As a part of the normal call procedure, the eNB instructs each UE to perform measurements on neighbour cells. When a UE sends a measurement report regarding another cell (cell B), the report contains Cell B's physical cell identifier (PCI) which is non-unique, but not its E-UTRAN Cell Global Identifier (ECGI), which is unique. When cell A's eNB receives a UE measurement report containing the PCI of cell B, the eNB instructs the UE, using the newly discovered PCI as parameter, to read the ECGI of the neighbour cell B and report the ECGI.

120. The relevant technical specification Section 5.5 of 3gPP TS 36.331 describes the Intra-LTE/frequency Automatic Neighbour Relation (ANR) function of the eNB in the serving cell. The disclosed technology is for eNB to send an instruction that a UE must follow during reporting. By focusing on letting UE obey such an instruction, the level of innovation is quite low. A POSITA would have recognized other practical alternatives such as reporting ECGIs of neighbor cells whose signal strengths exceed a preset threshold.

3. EP2485514

121. EP2485514 was issued to Johan Moe and Harald Kallin with a priority date of 2007-02-28. It belongs to the same family of patents as EP2119287 discussed above and discloses the same technology.

4. EP1230818

122. EP1230818 was issued to Ola Richard Svensson with priority date of 1999-11-17. It belongs to a family of patents that is declared to be essential to 3GPP TS 45.008 according to the ETSI database. It discloses a method for autonomously reporting measurement information from a mobile terminal active in a first wireless system to another (a second) communication

system or network. The terminal takes downlink measurement of the first system from a base-station. The measurement information reporting method begins at the terminal by first converting a plurality of downlink measurement values associated with the first said communication system to a plurality of downlink measurement values defined in the said second communication system. After comparing said converted plurality of downlink measurement values with at least one threshold value, the measurement report to the second system is triggered if at least one of said converted measurement values exceeds a predetermined threshold value. The terminal then sends at least one of the converted downlink measurement values on a control channel to a control node in said second communication system. This disclosed method may allow a terminal to update its connectivity from one connection protocol to another connection protocol when the measurement meets a pre-determined condition. If the measured channel condition is sufficient for a UE to connect from a 2G network (GSM) to a 3G network (UMTS) when associated with the same base-station, the method triggers UE measurement report to a control node. The patent described that, "[f]or example, Universal Mobile Telecommunication System (UMTS) measurement information can be conveyed from a mobile terminal (22) to a Base Station Controller (BSC) (14) in a Global System for Mobile Communications (GSM network." EP1230818 at Abstract.

123. The relevant technical specification Section 6.6.4 and Section 10.1.1.3 of 3GPP TS 45.008 (GSM, 2G) describes measurement of a UE in the 2G (GSM) network on cells of other radio access technologies such as 3G (UMTS). The disclosed technology is for a UE to perform reporting of converted measurement triggered by a measurement value exceeding a set threshold. By focusing on a threshold-triggered conversion and reporting, the level of innovation of this disclosed technology is low. A POSITA would have recognized other practical alternatives such

as reporting measurement be triggered when the current network speed is too slow or when the buffer of the current connection is too large.

5. EP1105991

124. EP1105991 was issued to Johan Nystrom and Branislav Popovic with priority date of 1998-8-17. It belongs to a family of patents that is declared to be essential to UMTS according to the ETSI database.

125. For a communication system such as the 3G UMTS cellular network using direct-sequence code division multiple access (DS-CDMA), finding the timing reference corresponds to finding the timing boundaries of downlink chips, symbols, and frames of the BS transmission. This search of BS timing is called "cell search," and it includes identification of BS-specific downlink scrambling codes used in UMTS (3G cellular). The slot and frame boundaries in the received signal are unknown to the MS to begin with, as are any BS-specific scrambling codes. The goal of the MS is thus to detect and identify one or more BSs in the received signal and to identify the scrambling code used. In UMTS, the scrambling codes are divided into 512 groups of 1 primary code and 15 secondary codes. EP1105991 discloses a method for detecting the scrambling code group of a received signal in a communication system.

126. The relevant technical specification Section 5.2.2 of 3GPP TS 25.213 (UMTS, 3G) describes the scrambling codes are divided into 512 groups of 1 primary code and 15 secondary codes to facilitate cell search in UMTS. The disclosed technology is for a UE to perform the detection of received scrambling code group using correlation by utilizing the scrambling code's characteristics already defined by 3GPP TS 25.213. By disclosing on ways to utilize the scrambling codes' characteristics during detection, the level of innovation of this disclosed technology is low A POSITA would have recognized other practical alternatives of detection

exists, such as non-coherently superimposing the magnitudes of correlations, or the sum energy of the correlation signals, in accordance with cyclic shifts of each of a plurality of sequences of signs, instead of applying coherent combination, for determining a maximal coherently combined correlation to identify the scrambling code group for the received signal.

B. HUAWEI PATENTS

1. US8416892

127. US 8,416,892 was issued to Oskar Mauritz, with a priority date of 2007-04-30. It belongs to a family of patents that is declared to be essential to 3GPP Technical specifications TS 36.211 (4G-LTE) according to the ETSI database. There are 64 preambles in each cell defined in 3GPP TS 36.211 v14.2.0.

128. When initiating a random access procedure, a mobile terminal transmits one of the 64 preambles. A message is transmitted to a base station by the mobile terminal selecting a particular preamble. This invention requires that a random access preamble be selected from a subset of random access preambles; wherein the subset of random access preambles is provided with Zero Correlation Zones of length Ncs-1, where Ncs is a cyclic shift increment selected from a pre-defined set of cyclic shift increments and the pre-defined set includes all of the following cyclic shift increments of 0, 13, 15, 18, 22, 26, 32, 38, 46, 59, 76, 93, 119, 167, 279, 419. These are specified in 3GPP TS 36.211 v14.2.0 in Table 5.7.2-2: NCS for preamble generation (preamble formats 0-3).

129. Random access is the initial phase of a UE connection when attempting to connect to the cellular network. The invention provides better random preamble sequences with nice correlation properties in a subset which shall be used in the random access to reduce interference by lowering correlations. The innovation level of this invention is superior to typical inventions

declared to ETSI. None of the Unwired Planet Patents relates to similar technology, or reflects as high a level of innovation, as the '892 Patent.

2. US8483166

130. US 8,483,166 was issued to Xiaolong Guo, with a priority date of 2007-11-01. It belong to a family of patents declared to be essential to 3GPP Technical specifications TS 33.401 (2G, 3G, 4G), TS 23.003 (2G, 3G), and TS 36.401 (4G-LTE) according to the ETSI database.

131. This invention relates to a solution that allows a UE to efficiently switch from an LTE network to access a legacy network. In the solution of the '166 patent, the UE places information from a temporary ID of an LTE network (GUTI) in an access message sent to a newly selected core network node (SGSN) in a legacy network. The newly selected SGSN can then use this information from the GUTI to obtain the context of a UE from the previously-assigned core network node (MME) in the LTE network. Cell reselection in areas where only legacy coverage exists would require a UE to be switched to a different MME for mobility management in the newly selected legacy network. The level of innovation is superior and tackles multiple levels of challenges, including security, MME identity, and user identity, that concern UE confidentiality. None of the Unwired Planet Patents relates to similar technology, or reflects as high a level of innovation, as the '166 Patent.

3. US8644239

132. US 8,644,239 was issued to Bingyu Qu, Yujuan He, and Xuan Feng, with a priority date of 2007-03-07. It belongs to a family of patents that is declared to be essential to 3GPP Technical specifications TS 36.211 (4G-LTE) according to the ETSI database. There are 64 preambles in each cell defined in 3GPP TS 36.211 v14.2.0.

133. This patent relates to the use of CAZAC sequences. In communication systems, the Constant Amplitude Zero Auto-Correlation (CAZAC) sequence is a very important communication resource. CAZAC sequence is typically used for synchronization, preamble, and channel estimation by the receiving units based on the nice autocorrelation property of the sequence. This invention provides ways to design better sequences from CAZAC such that multiple cells may select its own CAZAC that has lower correlation and mutual interference with other cells during the channel estimation process.

134. Sounding reference signals and uplink DMRS sequences are highly important for the eNodeB to estimate the channel quality of the UE uplink. Based on this information, the cellular network can provide good uplink resource allocation *and* perform uplink signal detection (based on DMRS) for data reception. Groups of sequences are studied and proposed for use in cellular uplink UE signaling of SRS and DMRS that is critical to maintaining strong network links and high efficiency. The proposed solution leads to more accurate channel estimation, as a result of lowering interferences from multiple transmitting UEs. The proposed solution improves channel estimation accuracy and is very important to the network. The innovation level of this work is exceptional. None of the Unwired Planet Patents relates to similar technology, or reflects as high a level of innovation, as the '239 Patent..

4. US8885587

135. US 8,885,587 was issued to Xiaobo Chen and Chaojun Li, with a priority date of 2009-12-03. It belongs to a family of patents that is declared to be essential to 3GPP Technical specifications TS 36.212 and TS 36.231 of 4G-LTE according to the ETSI database.

136. This patent relates to innovative ACK/NACK feedback implementations for enabling high rate carrier aggregation link. The invention enables a UE to receive data from

primary and secondary downlink component carriers, and efficiently feedback ACK/NACK information on a primary uplink component carrier. The invention uses a transmission power control (TPC) command as a common field within downlink control information. When a piece of downlink control information (DCI) is received from the primary downlink component carrier, which is system-linked with the primary uplink component carrier, the TPC command indicates transmission power control information for all ACK/NACK sent on the primary uplink component carrier. And when the piece of DCI is received from a secondary downlink component carrier (not system-linked with the primary uplink component carrier), the TPC command indicates an acknowledgement resource indicator for scheduling ACK/NACK feedback on the primary uplink component carrier.

137. Carrier aggregation is an important technology to allow higher bandwidth to be allocated to one UE to achieve higher data rates. The control channel information would be better handled by a single component carrier. By providing a compatible solution to accommodate such control channel information, the level of innovation is superior to typical inventions declared to ETSI. None of the Unwired Planet Patents relates to similar technology, or reflects as high a level of innovation, as the '587 Patent.

5. US8412197

138. US 8,412,197 was issued to Michael Roberts, Johan Johansson, Boyun XiE, and Min Huang, with a priority date of 2008-04-09. It belongs to a family of patents that is declared to be essential to 3GPP Technical specifications TS 25.331 (UMTS), TS 25.304 (UMTS), TS 36.331 (4G-LTE), and TS 36.304 (4G-LTE) according to the ETSI database.

139. The US 8,412,197 Patent discloses a priority-based cell reselection method to reduce the measurements by the terminal and save power energy, and possibly lead to better load

balance. In previous technical solutions, the terminal performs cell reselection in a non-LTE network by using a dedicated priority list established by the non-LTE mobile communication system. The Access Network (AN) node or the Core Network (CN) node has to add more signaling for establishment of the dedicated priorities, which leads to higher costs for network upgrade. The disclosed invention of this patent for reselection allows a dedicated priority list with valid time be established for an UE in an E-UTRAN network that is also applied when currently not on E-UTRAN network. The dedicated priority list is delivered in dedicated signaling of the LTE system with a valid time parameter. Within the valid time, the terminal will attempt to reselect a cell of the LTE system only when the signal quality of the current cell decreases to a certain level. The valid time and dedicated priority list may be delivered to the terminal by eNB via a RRC dedicated signaling in a Non-Access Stratum (NAS) message to the terminal by a CN node. Before the timer expires, the terminal camps on a cell which has the highest priority shown in the dedicated priority list. The terminal decides whether to perform cell reselection according to signal quality of the current cell. When the signal quality of the cell decreases to a preset threshold, the terminal may perform cell reselection according to the dedicated priorities and the valid time. Next, when the dedicated priority list is invalid, the terminal stops using the dedicated priority list and deletes the dedicated priority list. The terminal then uses the public priority list for cell reselection.

140. Cell reselection is critical in mobile wireless communication networks. The innovation of this patent's reselection allows a dedicated priority list with valid time be established for an UE in an E-UTRAN network that is also applied when currently not on E-UTRAN network. The solution reduces the measurements by the terminal and saves power or energy. Another advantage of a priority list may be to actively perform load balancing among cells. The innovation

level of this invention is superior. None of the Unwired Planet Patents relates to similar technology, or reflects as high a level of innovation, as the '197 Patent.

6. US8724613

141. US 8,724,613 was issued to Junwei Wang, Xiaoan Fan, and Jianghua Liu, with a priority date of 2007-02-12. It belongs to a family of patents that is declared to be essential to 3GPP Technical specifications TS 25.300 and TS 36.321 of 4G-LTE according to the ETSI database.

142. This particular part of the standard consists of the MBSFN provision and discussion in cellular systems. Multicast broadcast multimedia services do contribute significantly to the user experience and value of cellular networks.

143. The invention corresponds to the standard in that there is a unique pattern of frames and subframes specific to a MBSFN area, which are used to transmit services such as MBMS. The invention solves the problem of how to efficiently signal to the UEs the MBSFN position of the frames and subframes, which saves battery life of the UE and improves network efficiency. The innovation level of this invention is typical. None of the Unwired Planet Patents relates to similar technology.

C. SAMSUNG PATENTS

144. I have reviewed Mr. Davies' opinions regarding the "technical similarities between the Unwired Planet and Samsung Patents" in paragraphs 88 to 99 of his report.

145. In my opinion, Mr. Davies does not provide a sufficient basis to conclude that the Unwired Planet Patents and Samsung Patents are technically comparable.

146. Mr. Davies does not provide any analysis in his report regarding technical comparability and innovation, other than broadly stating that both the Unwired Planet Patents and

Samsung Patents "relate" to the LTE standard and that all of the patents are somehow novel and valuable. *See* Davies Rep. at ¶ 89. Mr. Davies only provides a one-sentence description of each patent that is insufficient to establish whether and how each patent "relates" to LTE.

147. Mr. Davies does not opine that the patents cover related technical subject matter. In fact, Mr. Davies suggests that the patents do not cover related technical subject matter, by stating that "each patent relates to a different aspect or subsystem of the LTE standard." *See Id*.

148. Mr. Davies provides no explanation of the novel features of each patent, and no explanation of the benefits of the patent. Mr. Davies does not assess or compare the quality of the Unwired Planet Patents or the Samsung Patents.

149. Due to lack of analysis in Mr. Davies' report, his conclusions about the technical similarities between the Unwired Planet Patents and Samsung Patents lack a sufficient basis and technical justification.

D. SUMMARY OF FINDINGS

150. To summarize, the Unwired Planet Patents are not technically comparable to the Huawei Patents. The Unwired Planet Patents do not relate to similar technology as the Huawei Patents, the Unwired Planet Patents display a much lower level of innovation, and a POSITA would have recognized viable alternatives to each of the Unwired Planet Patents. Mr. Davies does not provide a sufficient basis to conclude that the Unwired Planet Patents are technically comparable to the Samsung Patents.

Executed on this 25 day of May, 2018, in Davis, California.

By: _____
Dr. Zhi Ding

Appendix A

Expert/Consultant Curriculum Vitae

Professor Zhi Ding

Ph.D. and Fellow of IEEE

Expertise

- Wireless Communication Systems
- Cellular Wireless
- Communication networks
- Signal Processing and Analysis
- Digital Transmissions
- DSL and Cable Internet Service
- Digital Signal Processing
- WiFi, LTE, DOCSIS, Bluetooth

Professional Summary

- *Professor of major US universities for over 27 years.*
- *Consulted for major engineering companies such as Nortel, Analog Devices, Intel, and NEC*
- *Worked as expert on multiple patent infringement cases*.
- *Conducted research works on Communications and Signal Processing for over 30 years*.
- *Supervised over 25 PhD students*.
- *Author of more than 170 journal papers and 2 books on communication technologies*.

Dr. Zhi Ding has been a professor of electrical engineering at major US universities for 27 years. Since 1995, he has consulted for both engineering companies such as Nortel, Analog Devices, Intel, and worked as expert for major law firms such as Kirkland & Ellis, WilmerHale, Quin Emanuel, Fish & Richardson, on multiple technical and patent infringement cases. He has been conducting research works on wireless communications and signal processing since 1984. He has supervised over 25 PhD students. He is an author of 170 journal papers and 2 technical books on communication technologies. He has taught classes that cover the fundamentals of signal detection, communications, and systems.

Dr. Ding was appointed as the Child Family Professor of Engineering and Entrepreneurship in 2009-2014. He served as the steering committee chair of the IEEE Transactions on Wireless Communications. He was elevated to Fellow of IEEE in 2002 by the IEEE Signal Processing Society. He also served as the Technical Program Chair of the IEEE Globecom 2006 (the flagship conference of the IEEE Communications Society), Dr. Ding is an eminent scholar and expert of wireless technologies AND signal processing.

Expert/Consultant Curriculum Vitae

Consulting History (Partial List):

Past Client	Past Services
Kirkland & Ellis LLP	Expert consultant on various wireless (cellular and WiFi) and communications technologies since 2007. Major engagements include 2007-10: E. D. Texas, C.A. No. 2:07-CV-474 2008-10: E. D. Texas, C.A. No. 2:08-CV-247 2008: Apple License Consulting (M. Pieja) 2009: Apple Patent Analysis (B. Kwok) 2009: Cisco v. MOSAID matter (E. Lamison) 2009-10: D. Del. C.A. No. 07-CV-752 2008-10: D. Del. C.A. No. 07-md1848 2009-10: E.D. Texas, C.A. No. 5:09-cv-00101 2010-13: Netgear, Inc. & Ruckus Wireless Inc. Patent Matter, Netgear, Inc. & Ericsson Inc. Patent Matter. (E. Lamison) 2011-13: E. D. Texas, C.A. No. 6:10-cv-00473-LED 2011-13: N. D. Illinois, No. 1:11-cv-09308 2011-13: D. Del. Case No. 1:11-cv-00425 2013: Alcatel-Lucent Patent matters (B. Nguyen)
Wilmer Cutler Pickering Hale, and Dorr, LLP	Expert consultant on cellular wireless and communications technologies since 2010. Major engagements include 2009-11: D. Del. C.A. No. 09-791-GMS 2009-11: D. Del. C.A. No. 09-1002 and ITC Docket 2702 2011-13: Apple Inc. v. Samsung Electronics Co. (US, Japan, Korea, Germany, the Netherlands, UK, Italy, and others) including N. D. Cal, Case No. 11-cv-01846, ITC Docket Nos. 2824, 2827.
Fish and Richardson, LLP	Expert witness on cellular wireless and communications technologies for Marvell, Inc. Major engagements include 2014-15: *Inter Partes* Review of U.S. Patent 5,712,870 2014: *Inter Partes* Review of U.S. Patent 6,977,944
Kaye Scholer LLP	US District Court of Delaware 2009-10: D. Del. C.A. No. 07-CV-752 2008-10: D. Del. C.A. No. 07-md1848 Representing defendant as expert technical consultant against infringement accusations involving data over cable services. Case dropped by the plaintiff after expert reports 2008-2009. Attorney's fees recovered. 2012: C.D. Cal., CV 11-09373 RGK (RZx) 2012: D. Del., C.A. No. 10-1062-GMS
Bridges and Mavrakakis, LLP	IP Evaluation matters regarding client multi-billion dollar Patent portfolio purchase and other matters since 2011.

Expert/Consultant Curriculum Vitae

Sterne, Kessler, Goldstein & Fox PLLC	Technical consultant and expert declarant in Inter Partes Review Proceedings US Patents 7,477,624, 7,903,608, 8,542,643.
Bramson, Plutzik, Mahler &Birkhaeuser	2013: Expert witness for Plaintiff for a putative class action.
Gibson, Dunn & Crutcher, LLP	2014: Expert Consultant, for AT&T Mobility LLC and Cricket Communications, Inc., D. Del. Civil Action Nos. 13-1668 (LPS) 13-1669 (LPS)
Quinn Emanuel	2014: Expert technical consultant in Civil Action No. 1:13-cv-473 (D. Del.) (SLR)
Norton Rose Fulbright US LLP	2015-17: Technical consultant and expert witness in 1:14-cv-00436 (D. C. West Texas) and IPR2015-10577, IPR2015-10580, IPR-201510581.
Sheppard, Mullin, Richter, and Hampton, LLP	2015-17: Technical consultant and testifying witness in Case No. 8:14-cv-341 (C. D. CA).
Rothwell, Figg, Ernest, and Manbeck, P.C.	2016: Technical consultant and expert witness in 15-cv-01746-H-RBB (S. D. CA).
Mayer Brown LLP	2016-17: Technical consultant and expert testifying witness in Arbitration on SEP and licensing disputes.
Sidley Austin, LLP	
Irell & Manella, LLP	2016-17: Technical consultant and expert testifying witness on SEP and licensing disputes.
Venable, LLP	2016-17: Technical consultant and testifying witness regarding US Patent disputes.
	2017-18: Expert witness for Verizon Services Corp. in Case No. 2:16-CV-588-WCB (E. D. TX) on US Patent disputes.

Expert Witness/Deposition

Expert/Consultant Curriculum Vitae

Past Client	Past Services
Bramson, Plutzik, Mahler & Birkhaeuser LLP	2013: Deposition on Case No. CV 12-05240 PJH Nad Karim v. Hewlett Packard, Co. UNITED STATES NORTHERN DISTRICT COURT OF CALIFORNIA. Settlement ordered Jan. 18, 2017.
Fish and Richardson (Representing Marvell)	2015 (Feb. & August): 2 Depositions for Marvell. US PTAB *Inter Partes* Review IPR2014-00548 Marvell Semiconductor, Inc. v. Intellectual Ventures I LLC
Norton, Rose, Fulbright, US, LLP	2016 (April): Deposition for US PTAB *Inter Partes* Review IPR2015-10577, IPR2015-10580, IPR2015-10581, IPR2015-10581. Qualcomm Inc. v Bandspeed Inc.
Sheppard, Mullin, Richter, and Hampton, LLP	2016 (May): Deposition for TCL in *TCL Communication Technology Holdings, LTD., et al. v. Ericsson, et al.,* Case No. 8:14-cv-341 (C. D. CA). 2017 (Feb): Testified during court proceeding for TCL.
Sidley Austin, LLP Mayer Brown LLP	2016 (December): Testified for Huawei in Huawei Technologies, Co. Ltd v. Samsung Regarding FRAND licensing disputes in Shenzhen Court, P.R. China.
Venable LLP	2017 (January): Testified during tribunal proceeding for LG Electronics, Inc. in standard essential patent (SEP) licensing dispute of Nokia Technologies, Ltd. *v.* LG Electronics, Inc. During arbitration hearing in Paris, France. 2017 (October): Deposition as expert witness for Verizon Services Corp. in Case No. 2:16-CV-588-WCB (E. D. TX) on US Patent disputes.

Employment History

From:	2000	**University of California at Davis**
To:	Present	Davis, CA
	Position:	*Professor, Department of Electrical and Computer Engineering*

Expert/Consultant Curriculum Vitae

From: 01/1999 **University of Iowa**
To: 09/2000 Iowa City, IA
Position: *Assoc. Professor, Department of Electrical and Computer Engineering*

From: 01/1997 **Hong Kong University of Science and Technology**
To: 12/1997 Hong Kong
Position: *Visiting Associate Professor, Department of Electrical and Electronic Engineering*

From: 09/1995 **Auburn University**
To: 12/1998 Auburn, AL
Position: *09/1995-12/1998: Associate Professor, Department of Electrical and Computer Engineering*
09/1990-08/1995: Assistant Professor, Department of Electrical and Computer Engineering

From: 08/1993 **Australian National University**
To: 09/1993 Canberra, Australia
Position: *Visiting Research Fellow, Faculty of Information Technology and Engineering*

From: 06/1993 **US Air Force Wright Laboratory**
To: 08/1993 Eglin AFB, Florida
Position: *Faculty Research Associate, Armament Directorate*

From: 06/1992 **NASA Lewis Research Center**
To: 08/1992 Cleveland, OH
Position: *Visiting Faculty Research Fellow*

From: 08/1987 **Cornell University**
To: 08/1990 Ithaca, NY
Position: *Research Assistant*

From: 09/1984 **University of Toroto**
To: 08/1987 Toronto, Ontario, Canada
Position: *Research Assistant*

Patents (Granted and/or Licensed)

Patent Number	Date Issued	Title
US 6,396,885	Mar.28, 2002	Co-channel interference reduction in wireless communications systems (Nortel)
US 6,463,099	Oct.8, 2002	Blind channel equalizers and methods of blind channel equalization (Licensed)
US 7,379,513	Mar. 20, 2008	Channel estimation in CDMA communications systems using both lower power pilot channel and higher power date channel

Education

1990	Cornell University, Ithaca, NY	Ph.D., Electrical Engineering
1987	University of Toronto, Toronto, Canada	MS, Electrical Engineering
1982	Nanjing Institute of Technology, Nanjing, China	BS, Wireless Engineering

Publications

Books & Book Chapters

[1] B. P. Lathi and Z. Ding, *Modern Digital and Analog Communication Systems,* 4th edition, Oxford University Press, 2009 (in Press).

[2] Zhi Ding and Ye Li, *Blind Equalization and Identification*, Marcel Dekker, New York, 2001.

[3] Z. Ding, "Chapter 7: Linear Predictive Algorithms for Blind Multichannel Identification," in *Signal Processing Advances in Wireless and Mobile Communications*, Vol. I: Trends in Channel Estimation and Equalization, G. B. Giannakis, Y. Hua, P. Stoica, and L. Tong (Editors), Prentice Hall, 2000.

[4] Z. Ding, "Blind Channel Identification and Equalization using Spectral Correlation Measurements: Frequency Domain Analysis," in *Cyclostationarity in Communications and Signal Processing*, William A. Gardner, Ed., pp.417-436, IEEE Press, 1993.

[5] Z. Ding, C. R. Johnson, Jr., and R. A. Kennedy, "Chapter 3: Global Convergence Issues with Linear Blind Adaptive Equalizers," in *Blind Deconvolution*, Simon Haykin, Ed., pp.60-120, Prentice-Hall, 1994.

[6] Z. Ding, "Adaptive Filters for Blind Equalization," in *IEEE DSP Handbook*, Douglas B. Williams, Ed., pp.24.1-24.17, IEEE Press, 1998.

Journal Papers

[1] W. Wu and Z. Ding, ``On Efficient Packet-Switched Wireless Networking: A Markovian Approach to Trans-layer Design and Optimization of ROHC," in IEEE Transactions on Wireless Communications , vol.PP, no.99, pp.1-1 doi: 10.1109/TWC.2017.2694840

[2] W. Wu, H. Mittelmann, and Z. Ding, ``Modulation Design for MIMO-CoMP HARQ," IEEE Communications Letters, vol.21, no.2, pp.290-293, Feb. 2017. doi:

10.1109/LCOMM.2016.2618796

[3] X. Liang, Z. Ding and C. Xiao, ``On Linear Precoding of Non-Regenerative MIMO Relay Networks For Finite-Alphabet Source,'' *IEEE Transactions on Vehicular Technology,* vol. 66, no. 11, pp. 9761-9775, Nov. 2017. doi: 10.1109/TVT.2017.2717925

[4] X. Liang; M. Yuan; J. Wang; Z. Ding; M. Jiang; C. Zhao, ``Constellation Design Enhancement for Color-Shift Keying Modulation of Quadrichromatic LEDs in Visible Light Communications,'' *Journal of Lightwave Technology,* vol.PP, no.99, pp.1-1, 2017. doi: 10.1109/JLT.2017.2720579

[5] Dongrun Qin and Zhi Ding, ``Transport capacity analysis of wireless in-band full duplex ad hoc networks.'' *IEEE Transactions on Communications,* vol. 65, no. 3, pp.1303-18, March 2017. doi: 10.1109/TCOMM.2016.2640278

[6] L. Jing, C. He, J. Huang and Z. Ding, ``Energy Management and Power Allocation for Underwater Acoustic Sensor Network,''*IEEE Sensors Journal,* vol. 11, no. 11, pp. 1789-1796, August 2017. doi: 10.1109/JSEN.2017.2737229

[7] Lianyou Jing, C. He, Jian-guo Huang, and Z. Ding, ``Joint Channel Estimation and Detection Using MCMC Method over Sparse Underwater Acoustic Channels''. *IET Communications,* May 2017. doi: 10.1049/iet-com.2016.1339

[8] L. Jing, H. Wang, C. He and Z. Ding, ``Spatial CCK Modulation and Iterative Detection over Frequency-Selective Fading Channels,'' *IEEE Wireless Communications Letters,* vol.PP, no.99, pp.1-1 doi: 10.1109/LWC.2017.2709315

[9] X. Ling, J. Wang, X. Liang, Z. Ding, C. Zhao, and X. Gao ``Biased Multi-LED Beamforming for Multicarrier Visible Light Communications,'' IEEE Journal on Selected Areas in Communications, 2017. doi: 10.1109/JSAC.2017.2774539

[10] Hesham Elmaghraby and Zhi Ding, ``Scheduling and Power Allocation for Hybrid Access Cognitive Femtocells,'' *IEEE Transactions on Wireless Communications* vol.16, No.4, pp. 2520-2533, April 2017.

[11] Chen Sun, Xiqi Gao, and Zhi Ding. ``BDMA in Multi-Cell Massive MIMO Communications: Power Allocation Algorithms.'', *IEEE Transactions on Signal Processing,* vol. 65, No. 11, pp. 2962-74, June 2017.

[12] Qimei Chen, Guanding Yu, Hesham M. Elmaghraby, Jyri Hamalainen, Zhi Ding, ``Embedding LTE-U within Wi-Fi Bands for Spectrum Efficiency Improvement'', *IEEE Network*, Vol.31, No. 2, pp. 72-79, March 2017.

[13] K. Wang; Z. Ding, ``FEC Code Anchored Robust Design of Massive MIMO Receivers,'' in *IEEE Transactions on Wireless Communications,* vol.15, no.12, pp.8223-8235, 2016, doi: 10.1109/TWC.2016.2613516

[14] Q. Chen, G. Yu and Z. Ding, ``Optimizing Unlicensed Spectrum Sharing for LTE-U and WiFi Network Coexistence,'' in *IEEE Journal on Selected Areas in Communications,* vol. 34, no. 10, pp. 2562-2574, Oct. 2016. doi: 10.1109/JSAC.2016.2604998

[15] Z. Zheng; J. Hamalainen; Z. Ding, ``On the sum rate of fair resource allocation with selective

feedback," in *IEEE Transactions on Wireless Communications*, vol.15, no.8, pp.5193 - 5205, doi: 10.1109/TWC.2016.2554579

[16] D. Qin and Z. Ding, ``Exploiting Multi-Antenna Non-Reciprocal Channels for Shared Secret Key Generation,"in *IEEE Transactions on Information Forensics and Security,* vol. 11, no. 12, pp. 2693-2705, Dec. 2016. doi: 10.1109/TIFS.2016.2594143

[17] Han, Huy-Dung, Zhi Ding, and Muhammad Zia. ``A Convex Relaxation Approach to Higher-Order Statistical Approaches to Signal Recovery." *IEEE Transactions on Vehicular Technology*, vol.PP, no.99, pp.1-1 doi: 10.1109/TVT.2016.2542108

[18] H. Wang; C. Zhu; Z. Ding, ``Femtocell Power Control for Interference Management Based on Macro-Layer Feedback," IEEE Transactions on Vehicular Technology, vol.64, no.6, pp.5222-5236 July 2016. doi: 10.1109/TVT.2015.2463718

[19] W. Wu, H. Mittelmann, and Z. Ding, ``Modulation Design for Two-Way Amplify-and-Forward Relay HARQ," IEEE Wireless Communications Letters, vol.5, no.3, pp.244-247, June 2016. doi: 10.1109/LWC.2016.2530659

[20] K. Wang; Z. Ding, ``Diversity Integration in Hybrid-ARQ with Chase Combining under Partial CSI," in IEEE Transactions on Communications, vol.64, no.6, pp.2647-2659, June 2016. doi: 10.1109/TCOMM.2016.2553664

[21] Xintong Ling, J. Wang, X. Liang, Z. Ding, C. Zhao, Offset and power optimization for DCO-OFDM in visible light communication systems," *IEEE Transactions on Signal Processing*, 64(2), 349-363, 2016.

[22] H. Tang and Z. Ding, ``Mixed Mode Transmission and Resource Allocation for D2D Communication," IEEE Transactions on Wireless Communications, vol. 15, no. 1, pp. 162-175, Jan. 2016. doi: 10.1109/TWC.2015.2468725

[23] X. Ling, J. Wang, X. Liang, Z. Ding and C. Zhao, ``Offset and Power Optimization for DCO-OFDM in Visible Light Communication Systems," IEEE Transactions on Signal Processing, vol. 64, no. 2, pp. 349-363, Jan.15, 2016. doi: 10.1109/TSP.2015.2477799

[24] H. Wang, J. Wang and Z. Ding, ``Distributed Power Control in a Two-Tier Heterogeneous Network," IEEE Transactions on Wireless Communications, vol. 14, no. 12, pp. 6509-6523, Dec. 2015. doi: 10.1109/TWC.2015.2456055

[25] Bi, Suzhi, Rui Zhang, Zhi Ding, and Shuguang Cui. ``Wireless communications in the era of big data." IEEE Communications Magazine, vol. 53, no. 10, pp. 190-199, October 2015. doi: 10.1109/MCOM.2015.7295483

[26] Michal Cierny, Zhi Ding, and Risto Wichman. ``Higher Rank Interference Effect on Weak Beamforming or OSTBC Terminals." IEEE Transactions on Wireless Communications, vol. 14, no. 9, pp. 4948-4957, Sept. 2015. doi: 10.1109/TWC.2015.2429648

[27] Haile, B.B.; Dowhuszko, A.A.; Hamalainen, J.; Wichman, R.; Ding, Z., ``On Performance Loss of Some CoMP Techniques Under Channel Power Imbalance and Limited Feedback,", IEEE Transactions on Wireless Communications, vol.14, no.8, pp.4469-4481, Aug. 2015. doi: 10.1109/TWC.2015.2421898

[28] Kun Wang, Hong Shen, Wenhao Wu, and Zhi Ding, Joint Detection and Decoding in LDPC-Based Space-Time Coded MIMO-OFDM Systems via Linear Programming" IEEE Transactions on Signal Processing, 63. 3411-3424. 2015. doi: 10.1109/TSP.2015.2422681

[29] Elsherif, A.R.; Wei-Peng Chen; Ito, A.; Zhi Ding, ``Resource Allocation and Inter-Cell

Interference Management for Dual-Access Small Cells," *IEEE Journal on Selected Areas in Communications,* vol.33, no.6, pp.1082-1096, June 2015. doi: 10.1109/JSAC.2015.2416990

[30] Elsherif, A.R.; Chen, Wei-Peng; Ito, A.; Z. Ding, ``Adaptive resource allocation for interference management in small cell networks," IEEE Transactions on Communications, vol.63, no.6, pp.2107-2125, June 2015. doi: 10.1109/TCOMM.2015.2420676

[31] Sun, C.; Gao, X.; Jin, S.; Matthaiou, M.; Ding, Z.; Xiao, C., ``Beam Division Multiple Access Transmission for Massive MIMO Communications," IEEE Transactions on Communications," vol.63, no.6, pp.2170-2184, 2015. doi: 10.1109/TCOMM.2015.2425882

[32] Sam Siu, Qing Ji, Wenhao Wu, Gangbing Song, and Zhi Ding, ``Stress wave communication in concrete: I. Characterization of a smart aggregate based concrete channel," *Smart Materials and Structures,* 23(12): 125030, Dec. 2014.

[33] Sam Siu, Qing Ji, Wenhao Wu, Gangbing Song, and Zhi Ding. ``Stress wave communication in concrete: II. Evaluation of low voltage concrete stress wave communications utilizing spectrally efficient modulation schemes with PZT transducers," *Smart Materials and Structures,* 23(12): 125031, Dec. 2014.

[34] Wang, Haining, and Zhi Ding, ``Power Control and Resource Allocation for Outage Balancing in Femtocell Networks," *IEEE Transactions on Wireless Communications,* 14, no. 4 (2015): 2043-2057. doi: 10.1109/TWC.2014.2379282

[35] Wu, Wenhao, Kun Wang, Weiliang Zeng, Zhi Ding, and Chengshan Xiao, ``"Cooperative Multi-Cell MIMO Downlink Precoding With Finite-Alphabet Inputs," *IEEE Transactions on Communications,* vol. 63, no. 3 (2015): 766-779. doi: 10.1109/TCOMM.2015.2388584

[36] Huan Tang, Zhi Ding, and B. C. Levy, ``Enabling D2D Communications Through Neighbor Discovery in LTE Cellular Networks," IEEE Transactions on Signal Processing, vol.62, no.19, pp.5157-5170, Oct.1, 2014. doi: 10.1109/TSP.2014.2348950

[37] Haining Wang; Zhi Ding, ``Macrocell-Queue-Stabilization-Based Power Control of Femtocell Networks," *IEEE Transactions on Wireless Communications*, vol.13, no.9, pp.5223-5236, Sept. 2014

[38] Zia, M.; Ding, Z., ``Bandwidth Efficient Variable Rate HARQ Under Orthogonal Space-Time Block Codes," IEEE Transactions on Signal Processing, vol.62, no.13, pp.3360-3370, July 2014 doi: 10.1109/TSP.2014.2327580

[39] Binbin Guan; Djordjevic, S.S.; Fontaine, N.K.; Linjie Zhou; Ibrahim, S.; Scott, R.P.; Geisler, D.J.; Zhi Ding; Ben Yoo, S.J., "CMOS Compatible Reconfigurable Silicon Photonic Lattice Filters Using Cascaded Unit Cells for RF-Photonic Processing," IEEE Journal of Selected Topics in Quantum Electronics, vol.20, no.4, pp.1,10, July-Aug. 2014 doi: 10.1109/JSTQE.2013.2296233

[40] Hong Shen; Zhi Ding; Dasgupta, S.; Chunming Zhao, "Multiple Source Localization in Wireless Sensor Networks Based on Time of Arrival Measurement,"IEEE Transactions on Signal Processing, vol.62, no.8, pp.1938-1949, April 15, 2014 doi: 10.1109/TSP.2014.2304433

[41] Dongrun Qin; Zhi Ding; Dasgupta, S., "On Forward Channel Estimation for MIMO Precoding in Cooperative Relay Wireless Transmission Systems," IEEE Transactions on Signal Processing, vol.62, no.5, pp.1265-1278, March 2014 doi: 10.1109/TSP.2013.2296880

[42] Elsherif, A.R.; Zhi Ding; Xin Liu, "Dynamic MIMO Precoding for Femtocell Interference

Mitigation," IEEE Transactions on Communications, vol.62, no.2, pp.648-666, February 2014 doi: 10.1109/TCOMM.2013.122913.130062

[43] Tseng, Po-Hsuan, Zhi Ding, and Kai-Ten Feng. "Cooperative Self-Navigation in a Mixed LOS and NLOS Environment", IEEE Transactions on Mobile Computing, 13, no. 2 (2014): 350-363. doi: 10.1109/TMC.2013.6

[44] Ahmed R. Elsherif, Zhi Ding, Xin Liu, and Jyri Hamalainen, ``Resource Allocation in Two-Tier Heterogeneous Networks through Enhanced Shadow Chasing," IEEE Transactions on Wireless Communications, vol. 12, no.12, pp. 6439-6453, Dec. 2013. doi:10.1109/TWC.2013.101813.130732

[45] Enyang Xu, Z.Ding, and S. Dasgupta, ``Target tracking and mobile sensor navigation in wireless sensor networks". IEEE Transactions on Mobile Computing, 12(1):177-186. 2013. doi: 10.1109/TMC.2011.262

[46] Jacklin, Neil, and Zhi Ding. "A linear programming based tone injection algorithm for papr reduction of OFDM and linearly precoded systems", IEEE Transactions on Circuits and Systems I: Regular Papers, vol. 60, no. 7 (2013): 1937-1945. doi: 10.1109/TCSI.2012.2230505

[47] M. Cierny, Haining Wang, R. Wichman, Zhi Ding, and C. Wijting, ``On Number of Almost Blank Subframes in Heterogeneous Cellular Networks," IEEE Transactions on Wireless Communications, vol.12, no.10, pp.5061-5073, October 2013.

[48] Zhe Jiang; Haiyan Wang; Zhi Ding, ``A Bayesian Algorithm for Joint Symbol Timing Synchronization and Channel Estimation in Two-Way Relay Networks,"IEEE Transactions on Communications, vol.61, no.10, pp.4271-4283, October 2013. doi:10.1109/TCOMM.2013.082813.110691

[49] Yongpeng Wu; Chengshan Xiao; Xiqi Gao; Matyjas, J.D.; Zhi Ding, "Linear Precoder Design for MIMO Interference Channels with Finite-Alphabet Signaling," IEEE Transactions on Communications, vol.61, no.9, pp.3766-3780, September 2013. doi: 10.1109/TCOMM.2013.072213.130132

[50] Xiao Liang; Chun-Ming Zhao; Zhi Ding, ""Piggyback Retransmissions over Wireless MIMO Channels: Shared Hybrid-ARQ (SHARQ) for Bandwidth Efficiency," IEEE Transactions on Wireless Communications, vol.12, no.8, pp.3770,3782, August 2013. doi: 10.1109/TWC.2013.051313.121098

[51] Kun-Yu Wang, Neil Jacklin, Zhi Ding, and Chong-Yung Chi, ``Robust MISO Transmit Optimization under Outage-Based QoS Constraints in Two-Tier Heterogeneous Networks," IEEE Transactions on Wireless Communications, 12 (4):1883-1897, April 2013. doi: 10.1109/TWC.2013.022013.121111

[52] Enyang Xu, Zhi Ding, and S. Dasgupta, ``Target Tracking and Mobile Sensor Navigation in Wireless Sensor Networks", IEEE Transactions on Mobile Computing, 12(1):177 - 186, Jan. 2013.

[53] F. E. Lapiccirella, X. Liu, and Z. Ding, ``Distributed Control of Multiple Cognitive Radio Overlay for Primary Queue Stability", IEEE Transactions on Wireless Communications, 12(1):112-122, January 2013. doi:10.1109/TWC.2012.121112.111783

[54] Shafi, A. Bashar, Zhi Ding, and Chengshan Xiao, ``On Secrecy Rate Analysis of MIMO Wiretap Channels Driven by Finite-Alphabet Input," IEEE TRANSACTIONS ON COMMUNICATIONS, 60 (12):3816-3825, Dec. 2012.

[55] Huy-Dung Han and Z. Ding, ``Steepest descent algorithm implementation for multichannel blind signal recovery", IET Communications, 6(18):3196-3203, December 2012.

[56] Y. Wu, C. Xiao and Z. Ding, X. Gao, and S. Jin, ``LINEAR PRECODING FOR FINITE-ALPHABET SIGNALING OVER MIMOME WIRETAP CHANNELS," IEEE Transactions on Vehicular Technology, 61(6): 2599-2612, 2012

[57] Y. Wu, M. Wang, C. Xiao, Z. Ding, X.-Q. Gao ``Linear Precoding for MIMO Broadcast Channels With Finite-Alphabet Constraints", IEEE Transactions on Wireless Communications, 11(8): 2906 - 2920, August 2012

[58] Neil Jacklin, Zhi Ding, Wei Chen, Chunqi Chang, ``Noniterative Convex Optimization Methods for Network Component Analysis" IEEE/ACM Transactions on Computational Biology and Bioinformatics, 9(5):1472-1481, Sept.-Oct. 2012

[59] F.~E. Lapiccirella, Z. Ding, and X. Liu, ``Cognitive Spectrum Access Control Based on Intrinsic Primary ARQ Information", IET Communications, 6(8):900-908, August 2012.

[60] X. Liang, Z. Ding and C. Xiao, ``OPTIMIZED POWER ALLOCATION FOR PACKET RETRANSMISSIONS OF NON-GAUSSIAN INPUTS THROUGH SEQUENTIAL AWGN CHANNELS", IEEE Transactions on Communications, 60(7): 1889-1902, 2012.

[61] T. Miyajima and Zhi Ding, ``Subcarrier Nulling Algorithms for Channel Shortening in Uplink OFDMA Systems," IEEE Transactions on Signal Processing, vol.60, no.5, pp.2374-2385, May 2012.

[62] C. Xiao, Y. R. Zheng, and Z. Ding, ``Globally optimal linear precoders for finite alphabet signals over complex vector Gaussian channels," IEEE Trans. Signal Process., vol.59, pp.3301-3314, July 2011.

[63] Li Zhang, Shu Lin, K. Abdel-Ghaffar, Zhi Ding, and Bo Zhou, ``Quasi-Cyclic LDPC Codes on Cyclic Subgroups of Finite Fields" , IEEE Transactions on Communications, 59(9):2330-2336, Sept. 2011

[64] Z. Muhammad, and Z. Ding, ``Blind Multiuser Detection for Synchronous High Rate Space-Time Block Coded Transmission", IEEE Transactions on Wireless Communications, Issue: 99, July 2011, Page(s): 2171 - 2185.

[65] S. Bashar, Z. Ding, C. Xiao, ``On the Secrecy Rate of Multi-Antenna Wiretap Channel under Finite-Alphabet Input", IEEE Communications Letters, Vol. 15, No. 5, 2011, Page(s): 527-529.

[66] Xiao Liang, Chunming Zhao, and Zhi Ding, ``Sequential Linear MIMO Precoder Optimization for Hybrid ARQ Retransmission of QAM Signals", IEEE Communications Letters, 15(9): 913 - 915, September 2011.

[67] Enyang Xu; Zhi Ding; Dasgupta, S.; ``Source Localization in Wireless Sensor Networks From Signal Time-of-Arrival Measurements", IEEE Transactions on Signal Processing, Volume: 59 , Issue: 6, June 2011, Page(s): 2887 - 2897

[68] S. Bashar, Z. Ding, and (G.) Y. Li, `` On Secrecy of Codebook-Based Transmission Beamforming under Receiver Limited Feedback," IEEE Transactions on Wireless Communications, Volume: 10 , Issue: 4, April 2011 , Page(s): 1212 - 1223

[69] Senhua Huang, Xin Liu, and Zhi Ding; ``Decentralized Cognitive Radio Control Based on Inference from Primary Link Control Information", IEEE Journal on Selected Areas in Communications, Volume: 29 Issue:2, February 2011; page(s): 394 - 406.

[70] Enyang Xu, Zhi Ding, Soura Dasgupta, ``Reduced Complexity Semidefinite Relaxation Algorithms for Source Localization based on Time Difference of Arrival," IEEE Transactions on Mobile Computing, vol. 99, no. 9, 2011.

[71] Djordjevic, S.S.; Luo, L.W.; Ibrahim, S.; Fontaine, N.K.; Poitras, C.B.; Guan, B.; Zhou, L.;

Okamoto, K.; Ding, Z.; Lipson, M.; Yoo, S.J.B.; ``Fully Reconfigurable Silicon Photonic Lattice Filters With Four Cascaded Unit Cells," IEEE Photonics Technology Letters, vol.23, no.1, pp.42-44, Jan.1, 2011

[72] Z. Shi, W. Xu, S. Jin, C. Zhao, and Z. Ding, ``On Wireless Downlink Scheduling of MIMO Systems With Homogeneous Users" IEEE Transactions on Information Theory, Volume 56, July 2010. page(s): 3367 - 3378.

[73] S. Song, S. Lin, K. Abdel-Ghaffar, Z. Ding, W.H. Fong, M.P.C. Fossorier, ``Burst Decoding of Cyclic Codes Based on Circulant Parity-Check Matrices," IEEE Transactions on Information Theory, Volume 56, March 2010. page(s): 1038 - 1047.

[74] M. Muhammad and Z. Ding, ``A Linear Programming Receiver for Blind Detection of Full Rate Space-Time Block Codes" IEEE Transactions on Signal Processing, Volume: Issue: 99, Nov. 2010.

[75] S. Huang, X. Liu, and Z. Ding, ``Optimal Transmission Strategies for Dynamic Spectrum Access in Cognitive Radio Networks," IEEE Transactions on Mobile Computing, Volume 8, No. 12, December 2009. Page(s):1636 - 1648

[76] C. He, J. Huang, and Z. Ding, ``A Variable-Rate Spread-Spectrum System for Underwater Acoustic Communications" IEEE Journal of Oceanic Engineering, 34(4): 624-633, Oct. 2009.

[77] W. Xu, C. Zhao, and Z. Ding, ``Optimisation of limited feedback design for heterogeneous users in multi-antenna downlinks" , Institution of Engineering and Technology Communications, Volume 3, Issue 11, Page(s):1724 - 1735, November 2009

[78] S. Bashar and Zhi Ding, ``Admission control and resource allocation in a heterogeneous OFDMA wireless network" IEEE Transactions on Wireless Communications, Volume 8, Issue 8, Page(s):4200 - 4210, August 2009

[79] Wei Xu, Chunming Zhao, and Zhi Ding, ``Limited Feedback Multiuser Scheduling of Spatially Correlated Broadcast Channels" , IEEE Transactions on Vehicular Technology, Volume 58, Issue 8, Page(s):4406 - 4418, Oct. 2009.

[80] C. Meng, J. Tuqan, and Z. Ding, `` A Quadratic Programming Approach to Blind Equalization and Signal Separation" IEEE Transactions on Signal Processing, 57(6): 2232-2244, June 2009.

[81] Wei Xu, Chunming Zhao, and Zhi Ding, ``Limited feedback design for MIMO broadcast channels with ARQ mechanism" IEEE Transactions on Wireless Communications, Volume 8, Issue 4, Page(s):2132 - 2141, April 2009.

[82] Xiaofei Dong and Z. Ding, ``Wireless Channel Estimation for Linear MIMO Transmission Precoding" IEEE Transactions on Communications, Volume 57, Issue 4, April 2009 Page(s):1151 - 1161

[83] Bo Zhou, Jingyu Kang, Ying Tai, Shu Lin, and Zhi Ding, ``High Performance Non-Binary Quasi-Cyclic LDPC Codes on Euclidean Geometries LDPC Codes on Euclidean Geometries," IEEE Transactions on Communications, Volume 57, Issue 5, May 2009, Page(s):1298 - 1311.

[84] S. D. Chitte, S. Dasgupta, and Zhi Ding, ``Distance Estimation From Received Signal Strength Under Log-Normal Shadowing: Bias and Variance", IEEE Signal Processing Letters, 16(3): 216 - 218, March 2009.

[85] X. Dong, Z. Ding, and S. Dasgupta, ``Performance Analysis of a Forward Link Channel Estimation Method for Wireless Multicarrier Systems," IEEE Transactions on Wireless Communications,, 7(8): 3026-3035, August 2008.

[86] Chunqi Chang, Zhi Ding, Yeung Sam Hung, and Peter Chin Wan Fung, ``Fast Network

Component Analysis (FastNCA) for Gene Regulatory Network Reconstruction from Microarray Data", Bioinformatics 2008 24(11):1349-1358.

[87] H. Sun, Z. Shi, C. Zhao, J. H. Manton, and Z. Ding, ``Progressive Linear Precoder Optimization for MIMO Packet Retransmissions Exploiting Channel Covariance Information", IEEE Transactions on Communications, Volume: 55, Issue: 5, page(s): 818-827, May 2008.

[88] H. Kameyama, T. Miyajima, and Z. Ding, ``Perfect Blind Channel Shortening for Multicarrier Systems", IEEE Transactions on Circuits and Systems, Volume: 55, Issue: 3, page(s): 851-860, April 2008.

[89] C. Meng, Z. Ding, and S. Dasgupta, ``A Semidefinite Programming Approach to Source Localization in Wireless Sensor Networks", IEEE Signal Processing Letters, Volume 15, 2008, Page(s):253 - 256

[90] Zhihua Shi, Haitong Sun, Chunming Zhao, and Z. Ding, ``Linear precoder optimization for ARQ packet retransmissions in centralized multiuser MIMO uplinks", IEEE Transactions on Wireless Communications, vol. 7, no. 2, February 2008, page(s): 736-745.

[91] Peter M. Hahn, Bum-Jin Kim, Thomas Stutzle, Sebastian Kanthak, William L. Hightower, Harvind Samra, Zhi Ding, and Monique Guignard, The Quadratic Three-dimensional Assignment Problem: Exact and Approximate Solution Methods, European Journal of Operational Research Volume 184, Issue 2, Pages 416-428, 16 January 2008.

[92] Y. Du, F.Xue, S. J. B. Yoo, and Z. Ding, "Security Enhancement of SPECTS O-CDMA Through Concealment Against Upstream DPSK Eavesdropping", Journal of Lightwave Technology, Volume 25, Issue 9, Sept. 2007 Page(s):2799 - 2806

[93] H. Sun and Z. Ding, Iterative Transceiver Design for MIMO ARQ Retransmissions With Decision Feedback Detection" IEEE Transactions on Signal Processing, vol. 55, pp. 3405-3416, July 2007.

[94] C. Yang, N. K. Fontaine, R. P. Scott, V. J. Hernandez, W. Cong, D. L. Harris, K. Okamoto, B. H. Kolner, Z. Ding, J. P. Heritage, and S. J. B. Yoo, ``Two-User 150-km Field Fiber Security Enhanced SPECTS O-CDMA Transmission", IEEE Photonics Technology Letters, Volume 19, Issue 11, June 1, 2007, Page(s):852 - 854.

[95] S. J. Yoo, J. P. Heritage, V. J. Hernandez, R. P. Scott, W. Cong, N. K. Fontaine, R. G. Broeke, J. Cao, S.-W. Seo, J.-H. Baek, F. M. Soares, Y. Du, C. Yang, W. Jiang, K. Aihara, Z. Ding, B. H. Kolner, Anh-Vu Pham, Shu Lin, F. Olsson, S. Lourdudoss, K. Y. Liou, S. N. Chu, R. A. Hamm, B. Patel, W. S. Hobson, J. R. Lothian, S. Vatanapradit, L. A. Gruezke, W. T. Tsang, M. Shearn, and A. Scherer, ``Spectral phase encoded time spread optical code division multiple access technology for next generation communication networks [Invited]", Journal of Optical Networking,, Volume 6, Issue 10, Pages 1210-1227, September 2007.

[96] Tongtong Li, Qi Ling, and Zhi Ding ``Transmit Delay Structure Design for Blind Channel Estimation over Multipath Channels," EURASIP Journal onWireless Communications and Networking, February 2007, Page(s)

[97] V.J. Hernandez, Wei Cong; Junqiang Hu; Chunxin Yang; Fontaine, N.K.; Scott, R.P.; Zhi Ding; Kolner, B.H.; Heritage, J.P.; Yoo, S.J.B.; ``A 320-Gb/s Capacity (32-User X 10 Gb/s) SPECTS O-CDMA Network Testbed With Enhanced Spectral Efficiency Through Forward Error Correction" IEEE Journal of Lightwave Technology, Volume 25, Issue 1, Jan. 2007 Page(s):79 - 86

[98] J. Roberson, X. Dong, and Z. Ding, ``Channel Estimation and Equalization Techniques in Downsampled ARQ Systems" , IEEE Transactions on Signal Processing, Volume 55, Issue 5, Page(s):2251 - 2262, May 2007.

[99] N. Ammar and Z. Ding, ``Blind Channel Identifiability for Generic Linear Space-Time Block

Codes", , IEEE Transactions on Signal Processing, Volume 55, Issue 1, Jan. 2007, Page(s):202 - 217.

[100] Y. Du, S. J. B. Yoo, and Z. Ding, ``Nonuniform Spectral Phase Encoding in Optical CDMA Networks" IEEE Photonics Technology Letters, Volume 18, Issue 23, Dec.1, 2006, Page(s):2505 - 2507.

[101] H. Sun, J. Manton, and Z. Ding, ``Progressive Linear Precoder Optimization for MIMO Packet Retransmissions Exploiting Channel Covariance Information", IEEE Journal on Selected Areas in Communications, Vol. 24, no.3, pp. 448-456, March 2006.

[102] H. Samra and Z. Ding, ``Retransmission Diversity Schemes for Multicarrier Modulations", IEEE Transactions on Wireless Communications. Vol. 5, no. 5, pp. 1142-1147, May 2006.

[103] N. Ammar and Z. Ding, ``Channel Identifiability under Space-Time Coded Modulations without Training" , IEEE Transactions on Wireless Communications. Vol. 5, no. 5, pp. 1003-1013, May 2006.

[104] T. A. Drumright and Z. Ding, ``QAM Constellation Classification based on Statistical Sampling for Distortive Channels", IEEE Trans. on Signal Processing. Vol.54, No.5, pp. 1575-1586, May 2006.

[105] H. Samra and Z. Ding, ``New MIMO ARQ Protocols and Joint Detection via Sphere Decoding," IEEE Transactions on Signal Processing, vol. 54, no.2, pp. 473-482, Feb. 2006.

[106] B. Parr, B. L. Cho, K. Wallace, and Z. Ding, ``Performance Analysis of a spectrally compliant ultra-wideband pulse design," IEEE Transactions on Wireless Communications, vol.4, No.5, pp. 2172-2181, September 2005.

[107] X. Tang and Z. Ding, ``Low-Complexity Iterative Equalization for EDGE with Bidirectional Processing," IEEE Transactions on Wireless Communications, vol. 4, No.5, pp.1963-1968, September, 2005.

[108] H. Samra and Z. Ding, ``A Hybrid ARQ Protocol using Integrated Channel Equalization," IEEE Transactions on Communications, vol. 53, No. 12, pp. 1996-2001, Dec. 2005.

[109] X. Dong, Z. Ding, and S. Dasgupta, ``Forward link channel estimation and precoding based on decimated feedback," IEEE Signal Processing Letters. Vol. 12, Issue 6, pp.445-448, Dec. 2005.

[110] H. Samra, Z. Ding, and P.M. Hahn, ``Symbol Mapping Diversity Design for Multiple Packet Transmissions," IEEE Transactions on Communications, Vol. 53, No.5, pp. 810-817, May 2005.

[111] S. Cui, M. Kisialiou, Z.-Q. Luo, and Z. Ding, ``Robust Blind Multiuser Detection Against Signature Waveform Mismatch base on second order cone programming," IEEE Transactions on Wireless Communications, Vol. 4, No. 4, pp. 1285-1291, July 2005.

[112] T. Li, W. Liang, Z. Ding, and J. K. Tugnait, ``Blind Multiuser Detection for Long-code CDMA Systems with Transmission-induced Cyclostationarity," EURASIP Journal on Wireless Communications and Networking, vol.2, pp.206-215, 2005

[113] T. Miyajima and Zhi Ding, ``Second-order statistical approaches to channel shortening in multicarrier systems", IEEE Transactions on Signal Processing, pp.3253 - 3264, vol.52, Nov. 2004.

[114] V. J. Hernandez, Y. Du, W. Cong, R. P. Scott, K. Li, J. P. Heritage, Z. Ding, B. H. Kolner, and S. J. B. Yoo, ``Spectral phase-encoded time-spreading (SPECTS) optical code-division multiple access for terbit optical access networks," IEEE Journal of Lightwave Technology, Vol.22, No. 11, pp. 2671-2678, 2004.

[115] H. Xu, S. Dasgupta, and Z. Ding, ``A Novel Channel-identification Method for Wireless Communication Systems", IEEE Transactions on Communications, vol.52, pp.1767-1776, Oct. 2004.

[116] Wing-Kin Ma, Pak-Chung Ching, and Zhi Ding, ``Semidefinite relaxation based multiuser detection for M-ary PSK multiuser systems", IEEE Transactions on Signal Processing, vol.52 pp.2862-2872, Oct. 2004.

[117] J. Liang and Z. Ding, ``FIR Channel Estimation through Generalized Cumulant Slice Weighting," IEEE Trans. Signal Processing, pp.657-667, Mar. 2004.

[118] J. Liang and Z. Ding, ``Nonminimum Phase FIR Channel Estimation Using Cumulant Matrix Pencils", IEEE Trans. Signal Processing, pp.2310-2320, Sept. 2003.

[119] J. Liang and Z. Ding, ``Blind MIMO System Identification Based on Cumulant Subspace Decomposition", IEEE Trans. Signal Processing, vol.51, pp.1457-1468, June 2003.

[120] Z. Ding and L. Qiu, ``Blind MIMO Channel Identification from Second Order Statistics using Rank Deficient Channel Convolution Matrix," IEEE Trans. on Signal Processing, pp.535-544, Feb. 2003.

[121] Q. Li, E.-W. Bai, and Z. Ding, ``Blind Source Separation of Signals with Known Alphabets using E-Approximation Algorithms", IEEE Trans. on Signal Processing, pp.1-10, Jan. 2003.

[122] B. Parr, B. Cho, K. Wallace, and Z. Ding, ``A Novel Ultra-Wideband Pulse Design Algorithm", IEEE Communications Letters, vol.7, pp. 219-222, Dec. 2002.

[123] J. Liang and Z. Ding, ``Multiuser Channel Estimation from Higher Order Statistical Matrix Pencil", EURASIP Journal on Applied Signal Processing, , vol. 49, no. 2, pp. 1417-1426, Dec. 2002.

[124] X. Tang and Zhi Ding, ``Error Propagation in Blind Sequence Estimation", IEEE Communications Letters, vol.6, pp. 265-267, June 2002.

[125] J. E. Mooney, Z. Ding, and L. S. Riggs, ``Performance Analysis of a GLRT Automated Target Discrimination Scheme," IEEE Transactions on Antenna and Propagation, 49(12):1827-1835, Dec. 2001.

[126] R. Lopez-Valcarce, Zhi Ding, and Soura Dasgupta ``Equalization and Interference Cancellation in Linear Multi-User Systems Based on Second Order Statistics" , IEEE Transactions on Signal Processing , vol. 49, no.9, pp. 2042-2049, 2001.

[127] Erwei Bai and Zhi Ding, ``Blind Decision Feedback Equalization of Time-Varying Channels with DPSK Inputs", IEEE Transactions on Signal Processing, vol.49, no.7, pp. 1533-1542, July, 2001.

[128] Junqiang Shen and Zhi Ding, ``Zero-Forcing Blind Equalization Based on Channel Subspace Estimates for Multiuser Systems", IEEE Transactions on Communications, pp.262-271, Feb. 2001.

[129] Zhi Ding and Jing Liang, ``A Cumulant Matrix Subspace Algorithm for Blind Single FIR Channel Identification", IEEE Transactions on Signal Processing, vol. 49, no. 2, pp. 325-333, Feb. 2001

[130] Ge Li and Zhi Ding, ``Semi-blind Channel Identification for Individual Data Bursts in GSM Wireless Systems", Signal Processing, 80(10):2017-2031, Oct. 2000.

[131] Zhi Ding and Zhi-Quan Luo, ``A Fast Linear Programming Algorithm for Blind Equalization", IEEE Transactions on Communications, COM-48(9):1432-1436, September 2000.

[132] Chor Tin Ma, Zhi Ding, and Sze Fong Yau, ``A Two Stage Algorithm for MIMO Blind Deconvolution of Colored Input Signals", IEEE Transactions on Signal Processing, SP-

48(4):1187-1192, April 2000.

[133] Chunqi Chang, Zhi Ding, Sze Fong Yau, and Francis H Y Chan, ``A Matrix-Pencil Approach to Blind Separation of Colored Nonstationary Signals", IEEE Transactions on Signal Processing, SP-48(3):900-907, March 2000.

[134] J.E. Mooney, Z. Ding, and L.S. Riggs, "Performance Analysis of an Automated E-pulse Target Discrimination Scheme," IEEE Trans. Antenna Propagation, vol. 48, pp. 619-628, Apr. 2000.

[135] Zhi Ding and Tuan Nguyen, ``Convergence Study of A Kurtosis Maximization Algorithm for Blind Signal Separation and Antenna Beamforming", IEEE Transactions on Signal Processing, 48(6):1587 -1596, June 2000.

[136] Junqiang Shen and Zhi Ding, ``Direct Blind MMSE Channel Equalization Based on Second Order Statistics", IEEE Transactions on Signal Processing, SP-48(4): 1015-1022, April 2000.

[137] Erwei Bai and Zhi Ding, ``Zero-Forcing Equalizability of FIR and IIR Multi-Channel Systems with and without Perfect Measurements", IEEE Transactions on Communications, vol.48, pp.~17-22, Jan. 2000.

[138] Erwei Bai and Zhi Ding, ``Invertibility of Sampled Data Systems", IEEE Transactions on Circuits and Systems, pp.~279-289, March 2000.

[139] Erwei Bai and Zhi Ding, ``Zero of Sampled Data Systems Represented by FIR Models", Automatica, vol.36, No.1, pp.121-123, , Jan. 2000.

[140] K. K. Borah, R. A. Kennedy, Z. Ding, and I. Fijalkow, ``Sampling and Profiltering Effects on Blind Equalizer Design", IEEE Transactions on Signal Processing, SP-49(1):209-218, Jan. 2000.

[141] J. K. Tugnait, L. Tong and Z. Ding, ``Single-User Channel Estimation and Equalization," IEEE Signal Processing Magazine, vol. 17, no. 3, pp. 17-28, 2000.

[142] J.K. Tugnait and Z. Ding, ``Channel Estimation, Equalization and Synchronization," pp. 14-16 in Highlights of Signal Processing for Communications, G.B. Giannakis (Ed.), IEEE Signal Processing Magazine, vol. 16, no. 3, pp. 14-50, 1999.

[143] J.E. Mooney, Z. Ding, and L.S. Riggs, `` Performance Analysis of a GLRT in Late-Time Radar Target Detection," Journal of Electromagnetic Waves and Applications vol. 13, pp. 1339-1341, 1999; also in Progress in Electromagnetic Research, vol. 24, pp. 77-96, 1999.

[144] Tongtong Li and Zhi Ding, ``Joint Transmitter-Receiver Optimization for Non-maximally Decimated Filterbank Precoding Systems", IEEE Transactions on Signal Processing, vol. 47, pp.2407-2414, Sept. 1999.

[145] Jie Zhu, X.-R. Cao and Z. Ding, ``An Algebraic Principle for Blind Separation of White Non-gaussian Sources", Signal Processing, vol.76, pp.105-115, 1999.

[146] Z. Mao and Zhi Ding, ``A Non-parametric Phase Estimation Method for SIMO Systems based on Second Order and Higher Order Statistics," IEEE Trans. on Signal Processing, pp. 843-847, March 1999.

[147] Jie Zhu, Zhi Ding and Xi-Ren Cao, ``Column-anchored Zeroforcing Blind Equalization for Multiuser Wireless FIR Channels", IEEE Journal on Selected Areas in Communications, pp.411-423, March 1999.

[148] Jon E. Mooney, Z. Ding, and L.S. Riggs, ``Robust Target Identification in White Gaussian Noise for Ultra-Wideband Radar Systems," IEEE Trans. Antenna and Propagation, vol.46, pp.1817-1823, Dec. 1998.

[149] Junqiang Shen and Zhi Ding, ``Edge Decision Assisted Decorrelators for Asynchronous CDMA

Channels", IEEE Transactions on Communications, pp. 438-445, March 1998.

[150] Zhi Ding and Ge Li, ``Single Channel Blind Equalization for GSM Cellular Systems", IEEE Journal on Selected Areas of Communications, vol.16, pp.1493-1505, October 1998.

[151] Raul A. Casas, C. Richard Johnson Jr., Rodney A. Kennedy, Zhi Ding, and Roberto Malamut, ``Blind Adaptive Decision Feedback Equalization: A Class of Channels Resulting in Ill-convergence from A Zero Initialization", Int. Journal of Adaptive Control and Signal Processing, vol.12, pp.~173-193, March 1998.

[152] Tuan Nguyen and Zhi Ding, ``Blind CMA Beamforming For Narrowband Signals with Multipath Arrivals", Int. Journal of Adaptive Control and Signal Processing, vol.12, pp.~157-172, March 1998.

[153] Darren B. Ward, Zhi Ding, and Rodney A. Kennedy, ``DOA Estimation for Broadband Signals Using Frequency Invariant Beamforming", IEEE Transactions on Signal Processing, 46(3), pp.~1463-1469, May 1998.

[154] Zhi Ding, ``Matrix Outer-product Decomposition Method for Blind Multiple Channel Identification," IEEE Trans. on Signal Processing, 45(12), pp.~3053-3061, 1997.

[155] Z. Ding, ``On Convergence Analysis of Fractionally Spaced Adaptive Blind Equalizers," IEEE Transactions on Signal Processing, pp.~650-657, March 1997.

[156] Z. Ding, ``Multipath Channel Identification Based on Partial System Information", IEEE Transactions on Signal Processing, pp.~235-240, Jan. 1997.

[157] Z. Ding, ``Characteristics of Band-limited Channels Un-identifiable from Second Order Cyclostationary Statistics" IEEE Signal Processing Letters, 3(5):150-152, May 1996.

[158] Y. Li, K. J. R. Liu, and Z. Ding, ``Length-and Cost-dependent Local Minima of Unconstrained Blind Channel Equalizers," IEEE Transactions on Signal Processing, 44(11):2726-2735, 1996.

[159] Y. Li and Z. Ding, ``Global Convergence of Fractionally Spaced Godard Adaptive Equalizers," IEEE Transactions on Signal Processing, SP-44:818-826, April 1996.

[160] Y. Li and Z. Ding, ``Convergence Analysis of Finite Length Blind Adaptive Equalizers," IEEE Transactions on Signal Processing, pp. 2120-2129, September 1995.

[161] Y. Li and Z. Ding, ``A Simplified Approach to Optimum Diversity Combining and Equalization in Digital Data Transmission," IEEE Transactions on Communications, pp. 2285-2288, August 1995.

[162] Y. Li and Z. Ding, ``ARMA System Identification Based on Second Order Cyclostationarity", IEEE Transactions on Signal Processing, pp. 34983-3493, December 1994.

[163] Y. Li and Z. Ding, ``A New Nonparametric Method for Linear System Phase Recovery from Bispectrum", vol. 41, pp. 415-419, IEEE Transactions on Circuits and Systems II, May 1994.

[164] Z. Ding and Y. Li, ``On Channel Identification Based on Second Order Cyclic Spectra", IEEE Transactions on Signal Processing, vol.42, pp. 1260-1264, May 1994.

[165] Z. Ding, ``Blind Equalization Based on Joint Minimum Mean Square Error Criterion," IEEE Transactions on Communications, vol.42, pp. 648-654, Feb/March/April 1994.

[166] J. Y. Hung and Z. Ding, ``Design of Currents to Reduce Torque Ripple in Brushless DC Motors," IEE Proceedings-B, vol.140, pp. 260-266, July 1993.

[167] Z. Ding and C. R. Johnson, Jr., ``On the non-vanishing stability of undesirable equilibria for FIR Godard blind equalizers," IEEE Transactions on Signal Processing, vol.41, pp. 1940-1944, May 1993.

[168] Z. Ding, R. A. Kennedy, B. D. O. Anderson, and C. R. Johnson, Jr., ``Local Convergence of the Sato Blind Equalizer and Generalizations Under Practical Constraints", IEEE Transactions on Information Theory, vol.39, pp. 129-144, Jan. 1993.

[169] R. A. Kennedy and Z. Ding, ``Blind Adaptive Equalizers for QAM Communication Systems Based on Convex Cost Functions," Optical Engineering, vol.31, pp. 1189-1199, June 1992.

[170] Z. Ding, C. R. Johnson, Jr., and R. A. Kennedy, ``On the (Non)Existence of Local Equilibria of Godard Blind Equalizers," IEEE Transactions on Signal Processing, vol.40, pp. 2425-2432, 1992.

[171] Z. Ding and R. A. Kennedy, ``On the Whereabouts of Local Minima For Blind Adaptive Equalizers," IEEE Transactions on Circuit and Systems II, vol.39, pp. 119-223, Feb. 1992.

[172] Z. Ding, R. A. Kennedy, B. D. O. Anderson, and C. R. Johnson, Jr., ``Ill-Convergence of Godard Blind Equalizers in Data Communications," IEEE Transactions on Communications, vol. COM-39, pp. 1313-1327, 1991.

[173] Z. Ding, C. R. Johnson, Jr., and W. A. Sethares, ``Frequency-dependent Bursting in Adaptive Echo Cancellation and its Prevention using Double-talk Detectors," Int. Journal of Adaptive Control and Signal Processing, pp. 219-236, May 1990.

Conference Publications

[1] L. Jing, H. Wang, C. He, and Z. Ding, ``Joint Channel Estimation and Detection of High Rate CCK Signaling in Underwater Communications", Proc. IEEE Wireless Communications and Networking Conference (WCNC), San Francisco, USA, Mar. 2017.

[2] Chen Jiang, Wenhao Wu, and Z. Ding, ``LTE Multimedia Broadcast Multicast Service Provisioning Based on Robust Header Compression." IEEE Wireless Communications and Networking Conference (WCNC), San Francisco, CA, USA, May 2017.

[3] Chen Jiang, Wenhao Wu, and Z. Ding, ``IP packet header compression and user grouping for LTE Multimedia Broadcast Multicast Services, " Proc. 2017 International Conference on Computing, Networking and Communications (ICNC), pp. 52-57, January 2017.

[4] Yang, Kai, Yuanming Shi, and Zhi Ding, ``Low-rank matrix completion for mobile edge caching in fog-RAN via riemannian optimization." IEEE Global Communications Conference (GLOBECOM), pp. 1-6, Dec. 2016.

[5] Huan Tang, Zhi Ding, and Bernard C. Levy, ``D2D Neighbor Discovery and Resource Scheduling through Demodulation Reference Signal." IEEE 84th Vehicular Technology Conference (VTC-Fall), September 2016.

[6] H. Tang and Z. Ding, "Monotone optimization for power control of D2D underlay with partial CSI," 2016 IEEE International Conference on Communications (ICC), Kuala Lumpur, 2016, pp. 1-6. doi: 10.1109/ICC.2016.7511619

[7] H. Wang and Z. Ding, "Joint power and rate optimization for co-channel small cells using Frank-Wolfe algorithm," 2016 IEEE International Conference on Communications (ICC), Kuala Lumpur, 2016, pp. 1-6. doi: 10.1109/ICC.2016.7511345

[8] Kun Wang and Zhi Ding, ``Robust receiver design based on FEC code diversity in pilot-contaminated multi-user massive MIMO systems", Proc. 2016 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), Shanghai, China, 2016. Pages: 3426 - 3430.

[9] Zhi Quan; Muyang Ye; Zhi Ding; Shuguang Cui ``Optimal linear cooperation for signal classification", Proc. 2016 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), Shanghai, China, 2016. Pages: 3631 - 3635.

[10] H. M. Elmaghraby and Z. Ding, ``Cognitive Femtocell Scheduling and Power Allocation Based on Channel Quality Report," 2015 IEEE Global Communications Conference (GLOBECOM), San Diego, CA, 2015, pp. 1-6. doi: 10.1109/GLOCOM.2015.7417849

[11] Xintong Ling; Jiaheng Wang; Xiao Liang; Zhi Ding; Chunming Zhao ``Joint Offset and Power

Optimization for Visible Light DCO-OFDM Systems," IEEE Global Communications Conference (GLOBECOM) San Diego, CA, 2015.

[12] Dongrun Qin; Zhi Ding ``On Transport Capacity of Full Duplex Ad Hoc Networks," IEEE Global Communications Conference (GLOBECOM) San Diego, CA, 2015.

[13] Chen Sun; Xiqi Gao; Shi Jin; Matthaiou, M.; Zhi Ding; Chengshan Xiao, ``Beam division multiple access for massive MIMO downlink transmission", 2015 IEEE International Conference on Communications (ICC), pp. 1970 - 1975, London, UK, 2015. DOI: 10.1109/ICC.2015.7248614

[14] Huan Tang and Zhi Ding ``Resource allocation in mixed mode Device-to-Device communications", 2015 IEEE International Conference on Communications (ICC), pp. 2554-2559, London, UK, 2015. DOI: 10.1109/ICC.2015.7248709

[15] Wang, Kun, Wenhao Wu, and Zhi Ding. ``Diversity combining in wireless relay networks with partial channel state information." 2015 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), pp. 3138-3142, Brisbane, Australia, May 2015.

[16] Elmaghraby, Hesham M., Dongrun Qin, and Zhi Ding, ``Downlink Scheduling and Power Allocation in Cognitive Femtocell Networks," In Cognitive Radio Oriented Wireless Networks [Proc. 10th Intl. Conf. Cognitive Radio Oriented Wireless Networks (CROWNCOM)], pp. 92-105. Springer International Publishing, Oct. 2015.

[17] Haining Wang and Zhi Ding, ``Power control and rate allocation for outage balancing in femtocell networks," IEEE Global Communications Conference (GLOBECOM), Austin, TX, December 2014.

[18] Alexis Dowhuszko, Jyri Hamalainen, and Zhi Ding, ``Opportunistic interference avoidance scheduling for underlay cognitive radio networks", 9th International Conference on Cognitive Radio Oriented Wireless Networks (CROWNCOM), July 2014.

[19] Ahmed R. Elsherif, Zhi Ding, Xin Liu, ``A Resource Allocation Scheme for Heterogeneous Networks Using Dynamic Programming Approach ," in IEEE 79th Vehicular Technology Conference, VTC-Spring 2014, May 2014, pp. 1-6.

[20] W. Wu, K. Wang, Z. Ding, and C. Xiao, ``Cooperative multi-cell MIMO downlink precoding for finite-alphabet inputs", in Proc. IEEE Int. Conf. Acoust., Speech, Signal Process. (ICASSP), pp. 464-468, Florence, Italy, May 2014, doi:10.1109/ICASSP.2014.6853639

[21] K. Wang, W. Wu, and Z. Ding, ``Joint detection and decoding of LDPC coded distributed space-time signaling in wireless relay networks via linear programming," in Proc. IEEE Int. Conf. Acoust., Speech, Signal Process. (ICASSP), pp. 1906-1910, Florence, Italy, May 2014, DOI: 10.1109/ICASSP.2014.6853930

[22] Ahmedin, A.; Elsherif, A.R.; Xin Liu; Hamalainen, J.; Wichman, R., ``Macrocell resource adaptation for improved femtocell deployment and interference management," 2014 World Congress on Computer Applications and Information Systems (WCCAIS), pp.1-6, 17-19 Jan. 2014, Tunisia.

[23] Huan Tang, Zhi Ding, S. J. B. Yoo, and Jyri Hamalainen. "Outage constrained joint precoding for D2D underlay cellular networks." In Global Communications Conference (GLOBECOM), 2013 IEEE, pp. 3540-3545. IEEE, 2013.

[24] Elsherif, Ahmed R.; Chen, Wei-Peng; Ito, Akira; Ding, Zhi, ``Design of dual-access-technology femtocells in enterprise environments," IEEE 24th International Symposium on Personal Indoor and Mobile Radio Communications (PIMRC), pp.2774-2779, 8-11 Sept. 2013. doi: 10.1109/PIMRC.2013.6666619

[25] Kun-Yu Wang, Haining Wang, Zhi Ding and Chong-Yung Chi, ``A Low-Complexity Algorithm for Worst-Case Utility Maximization in Multiuser MISO Downlink," in 2013 IEEE 78th Vehicular Technology Conference (VTC Fall), pp.1-5, 2-5 Sept. 2013.

[26] A. R. Elsherif, Wei-Peng Chen, A. Ito, Zhi Ding, "Adaptive small cell access of licensed and unlicensed bands," IEEE International Conference on Communications (ICC), pp.6327,6332, 9-13 June 2013. doi: 10.1109/ICC.2013.6655621

[27] H. Wang, Z. Ding, M. Cierny, and R. Wichman, IEEE International Conference on

Communications (ICC), pp.5183-5187, Budapest 9-13 June 2013. doi: 10.1109/ICC.2013.6655407

[28] Qing Ji, Michael Ho, Rong Zheng, Zhi Ding and Gangbing Song, ``An exploratory study of stress wave communication in concrete structures" SMART STRUCTURES AND SYSTEMS (Proc. 6th Int. Conf. on Structural Health Monitoring of Intelligent Infrastructure, vol. 15, no. 1, pp. 135-150, 2015, Hong Kong.

[29] Huan Tang; Chenxi Zhu; Zhi Ding, "Cooperative MIMO precoding for D2D underlay in cellular networks," IEEE International Conference on Communications (ICC), pp.5517-5521, 9-13 June 2013.

[30] Dowhuszko, A.A.; Hamalainen, J.; Elsherif, A.R.; Zhi Ding ``Performance of transmit beamforming for interference mitigation with random codebooks," 8th International Conference on Cognitive Radio Oriented Wireless Networks (CROWNCOM), pp. 190-195, 2013.

[31] A. Elsherif, Z. Ding, X. Liu, J. Hamalainen, and R. Wichman, ``Inference Driven Dynamic Access Scheme for Interference Management in Heterogeneous Networks", 8th International Conference on Cognitive Radio Oriented Wireless Networks (CROWNCOM), pp. 178-183, 2013.

[32] A. R. Elsherif, Zhi Ding, Xin Liu, J. Hamalainen, ``Shadow chasing enhancement in resource allocation for heterogeneous networks", IEEE Global Communications Conference (GLOBECOM), Page(s): 5531 - 5536, Anaheim, CA, 2012.

[33] Yong Li ; Lin Wang ; Zhi Ding ``Linear programming based joint detection of LDPC coded MIMO systems," IEEE Global Communications Conference (GLOBECOM), Page(s): 4043-48, Anaheim, CA, 2012.

[34] A.R. Elsherif, A. Ahmedin, Zhi Ding, and Xin Liu `` Adaptive precoding for femtocell interference mitigation", Proc.IEEE International Conference on Communications (ICC), Page(s): 4315 - 4320, 10-15 June 2012.

[35] Xiao Liang, Zhi Ding, and Chengshan Xiao, ``On linear precoding of non-regenerative MIMO relays for QAM inputs"Proc. IEEE International Conference on Communications (ICC), Page(s): 2439 - 2444, 10-15 June 2012

[36] Yongpeng Wu, Chengshan Xiao, Zhi Ding, Xiqi Gao, and Shi Jin ``Linear MIMO precoding in multi-antenna wiretap channels for finite-alphabet data", Proc. IEEE International Conference on Communications (ICC), Page(s): 2156 - 2160, 10-15 June 2012

[37] Yongpeng Wu, Mingxi Wang, Chengshan Xiao, Zhi Ding, and Xiqi Gao ``Linear precoding of finite alphabet signals in multi-antenna broadcast channels", Proc. IEEE International Conference on Communications (ICC), Page(s): 4257 - 4261, 10-15 June 2012.

[38] Huy-Dung Han, Chenxi Zhu, Yueqiao Xu, Yi Wang, and Zhi Ding Joint transmission using global codeword and codebook design for coordinated multipoint processing (CoMP) , Proc. 2012 IEEE Globecom Workshops (GC Wkshps), Page(s): 1118 - 1122, Anaheim, CA, USA, Dec. 2012.

[39] Enyang Xu, Zhi Ding, Soura Dasgupta, ``Urban source localization based on time of arrival measurement and street information" Proc. IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP) Page(s): 2621 - 2624, Kyoto, Japan, 25-30 March 2012.

[40] Hema Kumari Achanta, Soura Dasgupta, Zhi Ding, ``Optimum sensor placement for localization in three dimensional under log normal shadowing", 5th International Congress on Image and Signal Processing (CISP) , pp.~1898-1901, 16-18 Oct. 2012

[41] Zhe Jiang, Hai-yan Wang, Wang, Zhi Ding, ``Joint Symbol Timing and Channel Estimation in Two-Way Multiple Antenna Relay Networks", Proc. IEEE Vehicular Technology Conference (VTC Fall), 3-6 Sept. 2012

[42] Yang Zhang, Jiandong Li, Lihua Pang, and Zhi Ding ``Maximizing lifetime in multi-source multi-relay non-regenerative OFDM networks", Prof. IEEE 23rd International Symposium on Personal Indoor and Mobile Radio Communications (PIMRC), Page(s): 2259 - 2262, 9-12 Sept. 2012.

[43] Jacklin, N.; Zhi Ding `` A Convex Optimization Approach to Reducing Peak-to-Average-Power Ratio in OFDM", 2011 IEEE International Symposium on Circuits and Systems (ISCAS), 2011, Page(s): 973 - 976.

[44] Chengshan Xiao; Zheng, Y.R.; Zhi Ding, ``Design optimization of linear precoders for complex vector gaussian channelswith finite alphabet inputs", 2011 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), 2011, Page(s): 3272 - 3275.

[45] Binbin Guan; Fontaine, N.K.; Scott, R.P.; Geisler, D.J.; Djordjevic, S.S.; Ibrahim, S.; Cheung, S.; Tiehui Su; Pomerene, A.T.; Seaford, L.L.; Danziger, S.; Zhi Ding; Yoo, S.J.B., ``Dynamic sub-20 ns reconfiguration of a silicon CMOS photonic filter and filter shape measurement", 2011 Conference on Lasers and Electro-Optics (CLEO), 2011, Page(s): 1 - 2

[46] Lapiccirella, F.E.; Keqin Liu; Zhi Ding, ``Multi-Channel Opportunistic Access Based on Primary ARQ Messages Overhearing" Communications (ICC), 2011 IEEE International Conference on Publication Year: 2011 , Page(s): 1 - 5

[47] Yang Zhang; Jiandong Li; Lihua Pang; Zhi Ding, ``On Precoder Design for Amplify-and-Forward MIMO Relay Systems", 2011 IEEE Vehicular Technology Conference (VTC Fall), 2011, Page(s): 1 - 6

[48] Meng Shen; Chunming Zhao; Xiao Liang; Zhi Ding, ``Best-Effort Interference Alignment in OFDM Systems with Finite SNR", 2011 IEEE International Conference on Communications (ICC), 2011, Page(s): 1 - 6.

[49] Yang Zhang, Jiandong Li, Lihua Pang, Zhi Ding, ``Iterative InterCarrier Interference mitigation for mobile MIMO-OFDM systems", 2011 IEEE 22nd International Symposium on Personal Indoor and Mobile Radio Communications (PIMRC), 2011, Page(s): 959 - 963.

[50] Huy-Dung Han; Zhi Ding; Junqiang Hu; Dayou Qian, ``On Steepest Descent Adaptation: A Novel Batch Implementation of Blind Equalization Algorithms," 2010 IEEE Global Telecommunications Conference , Miami, FL, 2010, Page(s): 1 - 6.

[51] Senhua Huang, Xin Liu, and Zhi Ding, ``Distributed Power Control for Cognitive User Access based on Primary Link Control Feedback", Proc. Conference on Computer Communications (INFOCOM 2010), 14-19 March 2010, Page(s): 1-9, San Diego, USA.

[52] Enyang Xu, Zhi Ding, and Soura Dasgupta, ``Robust and Low Complexity Source Localization in Wireless Sensor Networks Using Time Difference of Arrival Measurement",, Proceedings of the IEEE Wireless Communications and Networking Conference (WCNC), April 2010, Sydney, Australia, Page(s): 18-21.

[53] Dasgupta, S.; Ibeawuchi, S.C.; Zhi Ding; ``Optimum sensor placement for localization under log-normal shadowing", 2010 International Symposium on Communications and Information Technologies (ISCIT), 2010; Page(s): 204 - 208.

[54] Huy-Dung Han and Zhi Ding, ``A blind channel shortening criterion based on high-order cumulants" IEEE International Conf. on Acoustics, Speech and Signal Processing, 14-19 March 2010, Page(s):3210 - 3213.

[55] Enyang Xu, Zhi Ding, Soura Dasgupta, ``Wireless source localization based on time of arrival measurement" IEEE International Conf. on Acoustics, Speech and Signal Processing, 14-19 March 2010, Page(s):2842 - 2845.

[56] Ibrahim, S.; Luo, L.W.; Djordjevic, S.S.; Poitras, C.B.; Zhou, L.; Fontaine, N.K.; Guan, B.; Cheung, S.; Ding, Z.; Okamoto, K.; Lipson, M.; Yoo, S.J.B.; ``Fully reconfigurable silicon photonic lattice filters with four cascaded unit cells," Optical Fiber Communication (OFC), 21-25 Mar. 2010, Page(s):1 - 3.

[57] S. Bashar and Z Ding, ``Optimum Power Allocation against Information Leakage in Wireless Network" IEEE Global Telecommunications Conference, Nov. 30 2009-Dec. 4, 2009, Page(s):1-6.

[58] Huy-Dung Han and Zhi Ding, ``A Convex Optimization Approach to Blind Channel Shortening in Multicarrier Modulations," IEEE Global Telecommunications Conference, Nov. 30 2009-Dec. 4, 2009.

[59] Huy-Dung Han, Junqiang Hu, and Zhi Ding, ``A bandwidth efficient design of IM/DD optical OFDM," Conference on Lasers and Electro-Optics and Conference on Quantum electronics and Laser Science Conf. (CLEO/QELS 2009), 2-4 June 2009 Page(s): 1 - 2

[60] Senhua Huang, Xin Liu, and Zhi Ding, ``Optimal Sensing-Transmission Structure for Dynamic

Spectrum Access", Proc. 28th IEEE Conference on Computer Communications (INFOCOM 2009), 19-25 April 2009, Page(s):2295 - 2303, Rio de Janeiro, Brazil.

[61] Linjie Zhou; Djordjevic, S.S.; Fontaine, N.K.; Zhi Ding; Okamoto, K.; Yoo, S.J.B., ``Silicon microring resonator-based reconfigurable optical lattice filter for on-chip optical signal processing" IEEE LEOS Annual Meeting Conference Proceedings (LEOS), 2009, Page(s): 501 - 502.

[62] Lapiccirella, Fabio E.; Huang, Senhua; Liu, Xin; Ding, Zhi; ``Feedback-based access and power control for distributed multiuser cognitive networks" Information Theory and Applications Workshop, 2009 8-13 Feb. 2009 Page(s):85 - 89

[63] Muhammad, Zia; Chen Meng, Zhi Ding, ``Blind detection of high rate orthogonal space-time block codes IEEE International Conference on Acoustics, Speech and Signal Processing, 19-24 April 2009 Page(s):2745 - 2748

[64] Huang, River; Zhi Ding, ``Precoder design for MIMO broadcast channels with power leakage constraints," IEEE International Conference on Acoustics, Speech and Signal Processing, 19-24 April 2009 Page(s):2385 - 2388

[65] Chang, Chunqi; Zhi Ding; Hung, Yeung Sam; ``Nonnegative Network Component Analysis by Linear Programming for Gene Regulatory Network Reconstruction" Proceedings of the 8th International Conference on Independent Component Analysis and Signal Separation, 2009. Pages: 395 - 402

[66] S. Bashar and Z. Ding, "Optimum routing protection against cumulative eavesdropping in multihop wireless networks", Proceedings of 2009 MILCOM, October 2009.

[67] S. Dasgupta, S.-R.C. Ibeawuchi, and Zhi Ding; ``Source localization using a maximum likelihood/semidefinite programming hybrid " 9th Int. Symp. on Communications and Information Technology, 28 - 30 Sept. 2009, Page(s):376 - 381

[68] S.D. Chitte, S. Dasgupta, and Zhi Ding, ``Source Localization from Received Signal Strength Under Log-Normal Shadowing: Bias and Variance" 2nd International Congress on Image and Signal Processing, 2009.

[69] Chang, Chunqi; Hung, Yeung Sam; Ding, Zhi; ``A new optimization algorithm for network component analysis based on convex programming" IEEE International Conf. on Acoustics, Speech and Signal Processing, 19-24 April 2009 Page(s):509 - 512

[70] Senhua Huang, Xin Liu, and Zhi Ding, ``Opportunistic Spectrum Access in Cognitive Radio Networks", INFOCOM 2008: IEEE 27th Conference on Computer Communications, 13-18 April. 2008, Page(s): 1427-1435.

[71] Jingyu Kang, Bo Zhou, Zhi Ding, and Shu Lin, ``LDPC coding schemes for error control in a multicast network", IEEE International Symposium on Information Theory, page(s): 822-826, 6-11 July 2008.

[72] S Bashar and Z Ding, ``Efficient Algorithms for Resource Allocation in Heterogeneous OFDMA Networks", 2008 IEEE Global Telecommunications Conference, Nov. 30 2008-Dec. 4 2008.

[73] M. Zia and Z Ding, ``Joint ARQ Receiver Design for Bandwidth Efficient MIMO Systems", 2008 IEEE Global Telecommunications Conference, Nov. 30 2008-Dec. 4 2008.

[74] J Kang, L Zhang, Z Ding, and S Lin, ``A Two-Stage Iterative Decoding of LDPC Codes for Lowering Error Floors", 2008 IEEE Global Telecommunications Conference, Nov. 30 2008-Dec. 4 2008.

[75] S.-R.C. Ibeawuchi, S. Dasgupta, Cheng Meng, and Zhi Ding, ``Source localization using a maximum likelihood/semidefinite programming hybrid " Proc. 3rd International Conference on Sensing Technology, Nov. 30 2008-Dec. 3 2008 Page(s):585 - 588.

[76] S Huang, X Liu, Z Ding, ``On Optimal Sensing and Transmission Strategies for Dynamic Spectrum Access," DySPAN 2008: New Frontiers in Dynamic Spectrum Access Networks, 14-17 October 2008.

[77] S Bashar, Z Ding, and Y. Li ``QOS aware resource allocation for heterogeneous multiuser OFDM wireless networks" , IEEE Workshop on Signal Processing Advances in Wireless

Communications, page(s): 535-539, 6-9 July 2008.

[78] Z. Shi, C. Zhao, and Z. Ding, ``Low Complexity Eigenmode Selection for MIMO Broadcast Systems with Block Diagonalization" IEEE International Conference on Communications, 19-23 May 2008 Page(s):3976 - 3981.

[79] W. Xu, C. Zhao, and Z. Ding, ``Efficient user Scheduling under Low Rate Feedback for Correlated MIMO Broadcast Channels" IEEE International Conference on Communications, 19-23 May 2008 Page(s):3976 - 3981.

[80] He Huang and Zhi Ding, ``Ergodic capacity maximizing MIMO ARQ precoder design based on channel mean information", Information Theory and Applications Workshop, 2008, Jan. 27 2008-Feb. 1 2008 Page(s):58 - 62

[81] Huang, Senhua; Ding, Zhi; Liu, Xin; ``Non-Intrusive Cognitive Radio Networks Based on Smart Antenna Technology", IEEE Global Telecommunications Conference, 26-30 Nov. 2007, Page(s):4862 - 4867.

[82] T. Kazemi and Z. Ding, ``Scalable MIMO ARQ Retransmission using Differential Space-Time Block Codes," Military Communications Conference, 29-31 October 2007.

[83] Ye, Xiaohui; Liu, Xin; Yoo, S. J. Ben; Ding, Zhi; Priority Collision Resolution - Distributed Coordination Function for Distributed Wireless Networks," IEEE Global Telecommunications Conference, 26-30 Nov. 2007 Page(s):4708 - 4713

[84] C. Chang, Z. Ding, Y.S. Hung, P.C.W. Fung, ``Fast Network Component Analysis for Gene Regulation Networks," 2007 IEEE Workshop Machine Learning for Signal Processing, page(s): 21-26, 27-29 August 2007

[85] Q. Ling, T. Li, and Z. Ding, ``A Novel Concept: Message Driven Frequency Hopping (MDFH)", 2007 IEEE International Conference on Communications, Glasgow, Scotland, 24-28 June 2007 Page(s):5496 – 5501.

[86] Ohara, K.; Hernandez, V.J.; Du, Y.; Ding, Z.; Yoo, S.J.B.; Horiuchi, Y.; ``Resiliency of OCDM-PON against near-far problem", Proc. 2007 Optical Fiber Communication and the National Fiber Optic Engineers Conference (OFC/NFOEC 2007), 25-29 March 2007, Anaheim, CA, pp. 1-3,

[87] Fontaine, N.K. Yang, C. Scott, R.P. Hernandez, V.J. Soares, F. Broeke, R. Perry, K. Nowak, G. Cong, W. Okamoto, K. Kolner, B.H. Ding, Z. Heritage, J.P. Yoo, S.J.B. ``SPECTS O-CDMA field trials using subpicosecond pulses and integrated encoders/decoders across 80.8-km and 150-km links", Proc. Photonics in Switching Conference, pp. 95-96, 19-22 August 2007.

[88] Xin Liu and Zhi Ding, ``ESCAPE: A Channel Evacuation Protocol for Spectrum-Agile Networks," 2nd IEEE International Symposium on New Frontiers in Dynamic Spectrum Access Networks (DySPAN), Dublin, Ireland, 17-20 April 2007, Page(s):292 - 302.

[89] Du, Y.; Yoo, S.J.B.; Ding, Z. ``Non-uniform spectral encoding of measured mode-locked laser pulses for performance enhancement of optical CDMA networks," 2006 Optical Fiber Communication Conference (OFC), 5-10 March 2006, Anaheim, CA.

[90] Haitong Sun, and Zhi Ding, ``Optimal Linear Transceiver Design for Mimo Flat Fading Channels Exploiting Channel Mean Feedback", IEEE Global Telecommunications Conference, Nov., 2006.

[91] Song, Shumei; Lin, Shu; Abdel-Ghaffar, Khaled; Ding, Zhi; Fossorier, Marc, "Cyclic Codes for Correcting Bursts of Errors or Erasures With Iterative Decoding" IEEE Global Telecommunications Conference, Nov., 2006.

[92] Dong, Xiaofei; Ding, Zhi; ``Downlink MIMO Channel Estimation for Transmission Precoding" IEEE Global Telecommunications Conference, Nov., 2006. .

[93] Evans, Ashley A.; Ben Yoo, S. J.; Ding, Zhi; ``Space-Time Coded Modulation and Detection in Coherent Freespace Optical Communications", IEEE Global Telecommunications Conference, Nov., 2006.

[94] Yang, C. ; Cong, W. ; Xue, F. ; Hernandez, V. J. ; Scott, R. P. ; Heritage, J. P. ; Kolner, B. H. ; Ding, Z. ; Yoo, S. J. B. ; ``Experimental Investigation on Using Phase Mask in Spectral-Phase-Encoded O-CDMA for Security Enhancement", European Conference on Optical Communications (ECOC), 24-28 Sept. 2006, Cannes, France, Page(s): 1 - 2.

[95] Chang, C.Q.; Hung, Y.S.; Fung, P.C.W.; Ding, Z.; Network Component Analysis for Blind Source Separation 2006 International Conference on Communications, Circuits and Systems Proceedings, Volume 1, 25-28 June 2006, Page(s):323 - 326.

[96] N. Ammar and Zhi Ding, ``Semi-Coherent Detection for Differential Space-Time Codes", Proceedings of 2006 IEEE International Conference on Communications, Istabul, Turkey, 2006.

[97] H. Sun and Z. Ding, ``Robust Precoder Design for MIMO Packet Retransmission over Imperfectly Known Flat Fading Channels", Proceedings of 2006 IEEE International Conference on Communications, Istabul, Turkey, 2006.

[98] Haitong Sun, Zhi Ding, and Chunming Zhao, ``Iterative Design of MIMO ARQ Transceiver for Decision Feedback Detection", IEEE 7th Workshop on Signal Processing Advances in Wireless Communications, 2-5 July 2006.

[99] X. Dong and Z. Ding, ``Channel Estimation and Bit-loading in Wireless Multicarrier Systems based on Decimated Signal Feedback" , Proceedings of 2006 IEEE International Conference on Communications, Istabul, Turkey, 2006.

[100] J. Roberson and Zhi Ding, ``A BICM Approach to Type-II Hybrid ARQ", Proceedings of 2006 IEEE International Conference on Acoustics, Speech and Signal Processing, Volume 4, 2006 Page(s):IV-273 - IV-276, 2006, Toulouse, France.

[101] J. Roberson and Z. Ding, ``Integration of Hybrid ARQ and Space-Time Coding through Embebded Quasi-Orthogonal Space-Time Block Codes," Proc. 40th Annual Conference on Informaiton Sciences and Systems, pp. 547-551. 22-24 March 2206.

[102] F. Xue, Y. Du, S. J. B Yoo, and Z. Ding, `` Security issues on spectral-phase-encoded optical CDMA with phase-masking scheme", Proc. 2006 Optical Fiber Communication Conference, March 5-10, 2006.

[103] X. Dong and Z. Ding, ``MIMO Channel Estimation Based on Ambiguity Resistant Filtering and Decimated Feedback", Proc. IEEE Globecom Conference, Vol. 5, pp.2958-2963, St. Louis, MO, 28 Nov.-2 Dec. 2005.

[104] F. Xue, Z. Ding, and S. J. B. Yoo, ``Design and Analysis of Coordinated Access Schemes for Code-Limited Optical-CDMA Networks", Proc. IEEE Globecom Conference, vol. 4, pp.1930-1935, St. Louis, MO, 2005.

[105] J. Roberson, X. Dong, Z. Ding, ``Joint Data Detection for Punctured ARQ Diversity Systems", Proc. International Conference on Acoustics, Speech, and Signal Processing, pp. III-1145-1148, 2005.

[106] T. Li, Q. Ling, and Z. Ding, ``Space-Time Design for Blind Estimation and Equalization over Frequency Selective Channels", Proc. Int. Conference on Acoustics, Speech, and Signal Processing, pp. III-441-444, 2005.

[107] H. Sun, H. Samra, Z. Ding, and J. Manton, ``Constrained Capacity of Linear Precoded ARQ in MIMO Wireless Systems", Proc. Int. Conference on Acoustics, Speech, and Signal Processing, pp. III-425-428, 2005.

[108] A. A. Farid, Z.-Q. Luo, and Z. Ding, ``Blind Channel Equalization based on Second Order Statistics", Proc. Int. Conference on Acoustics, Speech, and Signal Processing, pp. III-557-560, 2005.

[109] F. Xue, Z. Ding, and S. J. B. Yoo, ``Performance Evaluation of Optical CDMA Networks with Random Media Access Schemes", Proc. 2005 Optical Fiber Communication Conference, vol. 4, 6-11 March 2005.

[110] Fei Xue, Zhi Ding, S.J.B. Yoo, ``Performance analysis for optical CDMA networks with random access schemes", Proc. IEEE Global Telecommunications Conf., Volume 3, pp.1883-1887, Nov-Dec., 2004.

[111] J. Roberson, and Z. Ding, ``Joint channel estimation and detection of partial ARQ in OFDM", Conference Record of the Thirty-Eighth Asilomar Conference on Signals, Systems and Computers, Volume 1, Page(s):662 - 666, 7-10 Nov. 2004

[112] Haitong Sun; Mihaela van der Schaar, and Zhi Ding, `` ``Joint data compression and error

protection for collaborative transmission," 2004 International Conference on Image Processing, 2004, Volume 1, 24-27 Oct. 2004 Page(s):533 - 536.

[113] Larcher, Aymeric, Haitong Sun, M. van der Schaar, and Zhi Ding. ``Decentralized transmission strategy for delay-sensitive applications over spectrum agile network", Proc. 13h Intl. Packet Video Workshop, Dec. 2004.

[114] H. Sun, M. van der Schaar, and Zhi Ding, ``Joint data compression and error protection over wireless fading channels using LDPC codes" Proc. 38th Asilomar Conf. on Signals, Systems and Computers, Pacific Grove, CA, 2004, Page(s): 978 - 982 Vol.1

[115] S. Neugebauer and Z. Ding, ``A Turbo-Driven Known-modulus Blind Equalization Method", Proceedings of the 5th Workshop on Signal Processing Advances in Wireless Communications, pp. 36-40, Lisbon, Portugal, July 2004.

[116] N. Ammar and Z. Ding, ``Flat Fading Channel Estimation Under Generic Linear Space-Time Block Coded Transmissions", Proceedings of the IEEE International Communications Conference, pp.2616-2620, 2004.

[117] T. Li, Z. Ding, J. K. Tugnait, and W. Liang, ``Channel Identification and Signal Separation for Long-code CDMA Systems using Mulitple Linear Prediction Method", Proceedings of the IEEE Int. Communications Conference, pp. 2437-2441, 2004.

[118] N. Ammar and Z. Ding, ``Frequency Selective Channel Estimation in Time-Reversed Space-Time Coding",, Proceedings of the IEEE Wireless Communications and Networking Conference (WCNC), pp. 1838-1843, March 2004.

[119] T. A. Drumright and Z. Ding, ``Monte-Carlo Equalization and Estimation of Frequency Selective Channels under System Nonlinearity," Proceedings of the IEEE WCNC Conference, pp. 2432-2437, 2004.

[120] X. Dong, Z. Ding and S. Dasgupta, ``Fractional spaced dual channel estimation based on decimated feedback", Proceedings of the IEEE WCNC Conference, pp. 489-494, 2004.

[121] J. Roberson and Z. Ding, ``Joint Channel Identification in Punctured Hybrid ARQ Retransmissions", Proceedings of the IEEE WCNC Conference, pp. 2099-2104, 2004.

[122] Y. Du, S. J.B. Yoo, and Z. Ding, ``Non-uniform Spectrual Encoding for Enhanced Multi-user Performacne in Optical CDMA Networks", Proc. Conference on Lasers and Electro-Optics. Vol. 1, 2 pp. 2004.

[123] W. Cong, V. J. Hernandez, R. P. Scott, K. Li, J. P. Heritage, B. H. Kolner, Z. Ding, and S. J. B. Yoo, ``PERFORMANCE OF A 10GB/S OPTICAL CODE DIVISION MULTPLE ACCESS CHANNEL IN THE PRESENCE OF AN INTERFERER", Proceedings of the Conference on Lasers and Electro-Optics, Vol. 1, 3 pp., 2004.

[124] S. P. Neugebauer and Z. Ding, ``Blind SIMO Channel Estimation for CPM Using the Laurent Approximation", Proceedings of the IEEE Int. Symposium on Circuits and Systems (ISCAS)}, pp.676-679, 2004.

[125] J. Roberson and Zhi Ding, ``Joint semi-blind channel identification in punctured ARQ retransmissions", Proc. IEEE Int. Conf. on Acoustics, Speech, and Signal Processing, pp.II.421-4, May 2004.

[126] H. Samra, and Z. Ding, ``Sphere decoding for retransmission diversity in MIMO flat-fading channels," Proc. IEEE Int. Conf. on Acoustics, Speech, and Signal Processing, pp.IV.585-588, May 2004.

[127] H. Samra, Zhi Ding, and P. M. Hahn, ``Symbol mapping diversity design for packet retransmissions through fading channels", Proc. IEEE Global Telecommunications Conf., vol.4, pp.1989-1993, 1-5 Dec. 2003.

[128] T. A. Drumright, A. A. Tabarrok, and Zhi Ding, ``Array beamforming for long code CDMA under carrier drift", Proc. IEEE Globecom, vol.4, pp.2156-2160, 1-5 Dec. 2003.

[129] Wing-Kin Ma; Ching, P.C.; Ding, Z.; ``Efficient relaxed maximum-likelihood MPSK multiuser detection using semidefinite programming", 4th IEEE Workshop on Signal Processing Advances in Wireless Communications (SPAWC), 15-18 June 2003 Page(s):522 - 526

[130] T. Miyajima and Z. Ding, ``Multicarrier channel shortening based on second order output statistics", 4th IEEE Workshop on Signal Processing Advances in Wireless Communications (SPAWC), 15-18 June 2003 Page(s):145 - 149.

[131] Honghui Xu, Dasgupta, S. Zhi Ding ``A novel channel identification method for fast wireless communication systems with transmitter and receiver diversity," Proceedings of the 2003 International Symposium on Circuits and Systems, pp. II:9-12, 25-28 May 2003.

[132] H. Samra and Zhi Ding, ``Symbol mapping diversity in iterative decoding/demodulation of ARQ systems," IEEE International Conf. on Communications, vol.5, pp.3585-3589, May 2003.

[133] T. Li, J. K. Tugnait, and Zhi Ding, ``Channel estimation of long-code CDMA systems utilizing transmission induced cyclostationarity", Proc. IEEE Int. Conf. on Acoustics, Speech, and Signal Processing, pp.IV.105-8, April 2003.

[134] H. Samra, Zhi Ding, P.M. Hahn, ``Optimal symbol mapping diversity for multiple packet transmissions", Proc. IEEE Int. Conf. on Acoustics, Speech, and Signal Processing, pp.IV.181-4, April 2003.

[135] H. Xu, S. Dasgupta, and Zhi Ding, ``An improved feedback scheme for dual channel identification in wireless communication systems," Proc. IEEE Int. Conf. on Acoustics, Speech, and Signal Processing, pp.IV.77-80, April 2003.

[136] A. B. Parr, B. L. Cho, and Z. Ding, ``A new UWB pulse generator for FCC spectral masks", Proc. 57th IEEE Vehicular Technology Conference, Spring, Volume: 3, Page(s): 1664-1666 April 22-25, 2003

[137] N. Ammar and Z. Ding, ``On Blind Channel Identifiability Under Space-Time Coded Transmission", Proc. 36th Asilomar Conf., Nov., 2002.

[138] Xiangguo Tang and Zhi Ding, ``A simple iterative bi-directional equalization for EDGE wireless systems", IEEE Globecom, pp. 287-290, Taipei, Nov. 2002.

[139] Xiangguo Tang and Zhi Ding, ``Contradictory block arbitration for bi-directional decision feedback equalizers", IEEE Globecom, pp. 283-286, Taipei, Nov. 2002.

[140] H. Samra and Z. Ding, ``Precoded Integrated Equalization for ARQ Systems", Proc. of the 36th Asilomar Conf. on Signals, Systems, and Computers, Monterey, CA, Nov., 2002.

[141] N. Ammar and Z. Ding, ``Channel Estimation Under Space-Time Block-Coded Transmission", IEEE Sensor Array and Multichannel Signal Processing Workshop, Rosslyn, VA. Aug, 2002, pp. 422-426.

[142] J Liang, Z Ding, ``Higher order statistical approach for channel estimation usingmatrix pencils," IEEE International Conference on Communications (ICC), Volume: 1, page(s): 11-15, 28 April - 2 May 2002, New York.

[143] J. Liang and Z. Ding, ``A Higher Order Matrix Pencil Approach to Blind Channel Estimation," Proc. IEEE Int. Symposium on Circuits and Systems, Scottsdale, AZ, 2002.

[144] T. A. Drumright and Z. Ding, â€œModulation Classification of QAM Signals using Joint Characteristic Function," Proc. IEEE Int. Symposium on Circuits and Systems, Scottsdale, AZ, 2002.

[145] T. A. Drumright and Z. Ding, ``Gibbs Sampling Classification of QAM Signals in Frequency Selective Channels", 36th Asilomar Conf. on Signals, Systems and Computers, Asilomar CA, 2002, Page(s): 833-837.

[146] H. Samra and Z. Ding, ``Iterative Integrated Equalization for ARQ Systems", Int. Symp. on Info. Theory, Lausanne, Switzerland, Jun, 2002.

[147] H. Samra and Z. Ding, ``Integrated iterative equalization for ARQ Systems," IEEE Int. Conf. on Acoustics, Speech, and Signal Processing, Orlando, FL, 2002.

[148] J. Liang, Z. Ding, and S. Lin, ``Joint Equalization with LDPC Decoding under hybrid ARQ Scheme," 35th Asilomar Conference on Signals, Systems and Computers, Pacific Grove, CA, 2001.

[149] X.-G. Tang and Z. Ding, ``Turbo Equalization for EDGE System with DDF-SOVA," 35th Asilomar Conference on Signals, Systems and Computers, Pacific Grove, CA, Nov. 2001.

[150] S. Cui, Z. Luo, and Z. Ding, ``Robust CDMA Signal Detection in the Presence of User and Interference Signature Mismatch," Proc. 3rd IEEE Workshop on Signal Processing Advances in Wireless Communications, pp. 221-224, March 20-23, 2001.

[151] S. Cui, Z. Luo, and Z. Ding, ``Robust Blind Multiuser Detection against CDMA Signature Mismatch," Proc. Int. Conf. on Acoustics, Speech, and Signal Processing, pp. 2297-2300, Salt Lake City, May 2001.

[152] H. Xu, S. Dasgupta, and Z. Ding, ``A Novel Channel Identification Method for Fast Wireless Communication Systems," Pro. 2001 IEEE International Conference on Communications, pp. 2443-2448, 2001.

[153] J. Liang and Z. Ding, ``FIR Multichannel Identification using Weighted Cumulant Matrix," Proc. 34th Asilomar Conference on Signals, Systems and Computers, pp. 1573-1577, 2000.

[154] J. Liang and Z. Ding, ``A cumulant subspace approach to FIR multiuser channel estimation" Proc. 34th Asilomar Conference on Signals, Systems and Computers, pp. 616-620, 2000.

[155] Z. Ding and Li Qiu, ``Properties of matrix polynomials and MIMO channel identifiability from second order statistics", Proceedings of the 39th IEEE Conference on Decision and Control, vol. 5, Page(s): 4302 -4307 vol.5, 2000.

[156] X. Tang and Z. Ding, ``A Differential Correlation Approach to Blind Symbol Estimation," Proc. IEEE Wireless Communications and Networking Conference, Chicago, IL, September 2000.

[157] J. Liang and Z. Ding, ``A cumulant subspace approach to FIR multiuser channel estimation," Proc. 10th IEEE Workshop on Statistical Signal and Array Processing, pp. 616-620, Pocono Manor, PA, August 2000.

[158] E. Bai and Z. Ding, ``Blind decision feedback equalization of time-varying channels with DPSK inputs," Proceedings 2000 IEEE International Symposium on Circuits and Systems, Volume 4, 28-31 May 2000, 96 - 99

[159] E. Bai and Z. Ding, ``Zero-forcing equalizability of FIR and IIR multi-channel systems with and without perfect measurements," Proceedings 2000 IEEE International Symposium on Circuits and Systems, Volume 4, 28-31 May 2000, 699 - 701

[160] Zhu, J.; Cao, X.-R.; Ding, Z., ``An algebraic principle in blind separation of single source signal", Proceedings 2000 IEEE International Symposium on Circuits and Systems, Volume 4, 28-31 May 2000, Page(s):693 - 696.

[161] Xiangyang Zhuang, Zhi Ding, and A. Lee Swindlehurst, ``A Statistical Subspace Method for Blind Channel Identification in OFDM Communication", IEEE Int. Conf. on Acoustics, Speech, and Signal Processing, pp. 2493-2496, Istanbul, Turkey, May 2000.

[162] Jie Zhu, Wee Ser, and Zhi Ding, ``Blind ISI cancellation by anchoring an arbitrary impulse response coefficient of channels", IEEE Int. Conf. on Acoustics, Speech, and Signal Processing, pp. 2465-2468, Istanbul, Turkey, May 2000.

[163] Zhi Ding, S. Dasgupta, and R. Lopez-Valcarce, ``Interference cancellation and blind equalization for linear multi-user systems", IEEE Int. Conf. on Acoustics, Speech, and Signal Processing, pp. 145-148, Istanbul, Turkey, May 2000.

[164] Kennedy, R.A.; Hasnie, S.; Zhi Ding; McGinty, N.C.; ``Decision feedback equalization using fractionally spaced feedback filtering and vector quantization" Proc. 38th IEEE Conference on Decision and Control, . Volume 1, 7-10 Dec. 1999, Page(s):162 - 167.

[165] T. Li and Z. Ding, ``A Reduced-State Viterbi Algorithm for Blind Sequence Estimation of DPSK Sources," Proc. Global Telecommunications Conference (Globecom), pp. 2167-2171, Rio de Janeiro, Brazil, Dec. 1999.

[166] G. Li and Z. Ding, ``Blind Linear Equalization for GSM Signals in a Mobile Environment", Proc. IEEE Wireless Communications and Networking Conference, pp.801-804, New Orleans, LA, September, 1999.

[167] J. Shen and Z. Ding, ``Direct blind MMSE channel equalization based on second order statistics," 1999 IEEE International Conference on Communications, vol.3, pp.1537 -1541, Seattle, WA, June 1999.

[168] G. Li and Z. Ding, ``New Blind/semi-blind Equalization for GSM Systems", 1999 IEEE Workshop on Signal Processing Advances in Wireless Communications, pp.66-69, Annapolis, MD, May 1999.
[169] J. Shen and Z. Ding, ``Blind MMSE CDMA Detection in Multipath Channels", 1999 IEEE Workshop on Signal Processing Advances in Wireless Communications, pp.5-8, Annapolis, MD, May 1999.
[170] Z. Ding, ``Cumulant Matrix Subspace Algorithms for Blind Single FIR Channel Identification", 1999 IEEE Workshop on Higher Order Statistics, pp.85-88, June, Caesarea, Israel, 1999.
[171] Z. Ding, ``A Cumulant Matrix Subspace Algorithm for Blind Single FIR Channel Identification", SPIE Conference on Digital Wireless Communications, SPIE vol.3708, pp.193-201, April, Orlando, FL, 1999.
[172] J.E. Mooney, Z. Ding, and L.S. Riggs, "Performance Analysis of an Automated E-pulse Scheme in White Gaussian Noise," IEEE International Antennas and Propagation Symposium and URSI/USNC Radio Science Meeting, April, Orlando, FL, 1999.
[173] Junqiang Shen and Zhi Ding, ``Zero-Forcing Blind Equalization Based on Channel Subspace Estimates for Multiuser Systems", Proc. Int. Conf. on Acoustics, Speech, and Signal Processing}, Phoenix, AZ, March 1999.
[174] Z. Ding and G. Li, ``Feasibility of linear GSM blind channel equalization," Proc. Int. Telecommunications Symp., vol.1, pp.~359-364, Sao Paulo, Brazil, 1998.
[175] C. T. Ma, Z. Ding, and S. F. Yau, ``A Two-stage Algorithm for MIMO Blind Deconvolution of Colored Input Signals", Proceedings 9th IEEE SP Workshop on Statistical Signal and Array Processing, pp.~384-387, 1998.
[176] Chunqi Chang, Zhi Ding, Mark S.-F. Yau, and Francis H. Y. Chan, ``A Matrix-Pencil Approach to Blind Separation of Non-White Signals in White Noise", Proc. 1998 IEEE International Conf. on Acoustics, Speech, and Signal Processing, pp.2485-2488, Seattle, May 12, 1998.
[177] Zhi Ding, Iain Collings, Ruey-wen Liu, ``A New Blind Zeroforcing Equalizer for Multichannel Systems", Proc. 1998 IEEE International Conf. on Acoustics, Speech, and Signal Processing, pp.3177-3180, Seattle, May 12, 1998.
[178] Ge Li and Zhi Ding, ``Semi-Blind Channel Identification Used in GSM System," Proc. 1998 IEEE International Conf. on Acoustics, Speech, and Signal Processing, pp.3389-3392, Seattle, May 12, 1998.
[179] Zhi Ding and Ge Li, ``Single Channel Linear Blind Equalization for GSM Cellular Systems", Proc. 1998 IEEE International Conf. on Communications, Atlanta, June, 1998. pp. 355-359
[180] C. Chang, Z. Ding, S. F. Yau, and F. H. Y. Chan ``A Matrix-Pencil Approach to Blind Separation of Non-White Sources," Proc. International Symposium on Multimedia Information Processing, pp. 280-285, Taipei, Taiwan, December 1997.
[181] Jie Zhu, Xiren Cao, Zhi Ding, and Junqiang Shen, ``A Blind Intersymbol Interference Cancellation Method for Multi-user Systems with Channel Diversity", Proc. 1997 Asilomar Conference on Signals, Systems, and Computers, pp.565-569, Pacific Grove, 1997.
[182] Zhi Ding and Ge Li, ``New Methods of Blind Channel Equalization for GSM Systems", Proc. 1997 Asilomar Conference on Signals, Systems, and Computers, Pacific Grove, 1997.
[183] Zhi Ding, ``Blind Wiener Filter Estimation for Multi-Channel Systems Base on Partial Information," Proc. 1997 IEEE International Conf. on Acoustics, Speech, and Signal Processing, pp.3609-3612, April 1997.
[184] Tuan Nguyen and Zhi Ding, ``CMA Beamforming for Multipath Correlated Sources", Proc. 1997 IEEE International Conf. on Acoustics, Speech and Signal Processing, pp.2521-2524, April 1997.
[185] Rodney A. Kennedy, Deva K. Borah, and Zhi Ding, ``Discretization Issues for the Design of Optimal Blind Algorithms", Proc. 1997 IEEE International Conf. on Acoustics, Speech, and Signal Processing, pp.51-54, April 1997.
[186] Junqiang Shen and Zhi Ding, ``Blind Adaptive Multiuser CDMA Detection Based on a Linear Projection Constraint", Proc 1st IEEE Workshop on Signal Processing Advances in Wireless

Communications, pp.~261-264, Paris, France, April 1997.
[187] Kennedy, R.A.; Zhi Ding, ``Design and optimization of nonlinear mapping in decision feedback equalization," Proceedings of the 35th IEEE Decision and Control, Volume 2, Page(s):1888 - 1889, 11-13 Dec. 1996
[188] Z. Ding, ``An Outer-Product Decomposition Algorithm For Multichannel Blind Identification", Proc. 8th IEEE Workshop on Stat. Signal and Array Processing, pp.~132-135, Corfu, Greece, June 1996.
[189] Zhi Ding, ``On Convergence Analysis of Fractionally Spaced Adaptive Blind Equalizers", Int. Conf. on Acoustics, Speech, and Signal Processing, May 1996.
[190] J.E. Mooney, Z. Ding, and L.S. Riggs, "Robust Target Identification Using a Generalized Likelihood Ratio Test," Proc. 3rd International Conference on Ultra-Wideband, Short-Pulse Electromagnetics, pp.343-350, Albuquerque, NM, 1996.
[191] D. B. Ward, Z. Ding, and R. A. Kennedy ``Broadband DOA Estimation using Frequency-invariant Beam-space Processing", Int. Conf. on Acoustics, Speech, and Signal Processing}, pp.2892-2895, May 1996.
[192] R.A. Kennedy and Z. Ding, ``Quantizer Design and Optimization in Decision Feedback Equalization", Proc. 1996 Int. Symp. on Signal Proc. Applications, pp.614-617, August, Gold Coast Australia.
[193] Zhi Ding, ``A Blind Channel Identification Algorithm Based on Matrix Outer-Product", 1996 International Communications Conference, Dallas, TX. pp. 852-856.
[194] Casas, R.A.; Zhi Ding; Kennedy, R.A.; Johnson, C.R., Jr.; Malamut, R.; ``Blind adaptation of decision feedback equalizers based on the constant modulus algorithm", Proc. 29th Asilomar Conference on Signals, Systems and Computers, Volume 1, 30 Oct.-2 Nov. 1995 Page(s):698 - 702
[195] Zhi Ding, ``Myopic Channel Identification: Identifying unknown Channels based on known pulse shapes", 1995 IEEE Global Telecommunications Conference, vol.1, pp.670-674, Nov. 1995.
[196] Paul Burns* and Zhi Ding, ``Robustification of Cyclostationary Array Processing Techniques", Proc. Int. Conf. on Acoustics, Speech, and Signal Processing, pp. 1589-1592, Detroit, May 1995.
[197] Zhi Ding and Zhen Mao, ``Knowledge Based Identification of Fractionally Sampled Channels" Proc. Int. Conf. on Acoustics, Speech, and Signal Processing, pp. 1996-1999, Detroit, May 1995.
[198] Zhi Ding and Rodney A. Kennedy, ``An Algebraic Self-Training Algorithm for Multi-Channel Systems Identification", Equalizers", Proc. 33rd IEEE Conf. on Decision and Control Lake Buena Vista, FL, Dec. 1994.
[199] Y. Li and Zhi Ding, ``Global Convergence of Fractionally Spaced Godard Adaptive Equalizers", Proc. 28th Asilomar Conf. on Signals, Systems and Computers, pp.617-621, Nov. 1994.
[200] Zhi Ding and Rodney A. Kennedy, ``Algebraic Self-Training Algorithms for Multi-Channel System Identification and Equalization", Proc. 28th Asilomar Conf. on Signals, Systems and Computers, pp. 1453-1457, Pacific Grove, CA, Nov. 1994.
[201] Y. Li and Zhi Ding, ``Global Convergence of Adaptive Blind Equalizers", Proc. 4th Annual IEEE Dual-Use Technologies and Applications Conference, vol.II, pp. 402-411, Utica, NY, May 1994.
[202] Y. Li and Z. Ding, ``New Results on the Blind Identification of FIR Channels Based on Second Order Statistics", Proc. 1993 MILCOM, pp. 644-647, Boston, Oct. 1993.
[203] Y. Li and Z. Ding, ``A New Non-Parametric Cepstral Method for Blind Channel Identification from Cyclostationary Statistics", Proc. 1993 MILCOM, pp. 648-652, Boston, Oct. 1993.
[204] Y. Li and Z. Ding ``Blind Channel Identification Based on Second order Cyclostationary Statistics", Proc. 1993 IEEE ICASSP, pp. IV:81-84, Minneapolis, April 1993.
[205] J. Y. Hung and Z. Ding, ``Minimization of Torque Ripple in Permanent Magnet Motors," 1992 IEEE Industrial Electronics Conference, San Diego, CA.
[206] Z. Ding and Y. Li, ``Channel Identification Using Second Order Cyclic Statistics," Proc. 26th Asilomar Conf. on Signals, Systems, and Computers, Pacific Grove, CA, November 1992.
[207] Z. Ding, ``On Channel Identifiability Based on Second Order Cyclic Spectra," Proc. IEEE 1992

Milcom, San Diego, October 1992.

[208] K. Yamazaki, R. A. Kennedy, and Z. Ding, ``Candidate Admissible Blind Equalization Algorithms for QAM Communication Systems," Proc. 1992 IEEE Int. Conf. on Communications, pp. 1518-1522, June 1992.

[209] K. Yamazaki, R. A. Kennedy, and Z. Ding, ``Globally Convergent Blind Deconvolution Algorithms for Complex Data System," Proc. 1992 IEEE ICASSP, San Fransisco, CA, April 1992.

[210] Z. Ding and R. A. Kennedy, ``A New Adaptive Algorithm for Joint Blind Equalization and Carrier Recovery," Proc. 25th Asilomar Conf. on Signals, Systems, and Computers, pp. 699-703, Pacific Grove, CA, November 1991 (Invited).

[211] Z. Ding and C. R. Johnson, Jr., ``Existing Gap Between Theory and Application of Blind Equalization," Adaptive Signal Processing, Simon Haykin, Editor, Proc. SPIE 1565, pp. 154-165, 1991 (Invited).

[212] Z. Ding, ``A New Method for Automatic Beamforming," Proc. 25th Asilomar Conf. on Signals, Systems, and Computers, pp. 689-693, Pacific Grove, CA, November 1991.

[213] Z. Ding, C. R. Johnson, Jr., and R. A. Kennedy, ``Local Convergence of `Globally Convergent' Blind Adaptive Equalization Algorithms," Proc. 1991 IEEE ICASSP, pp. 1529-1532, Toronto, Canada, May 1991.

[214] Z. Ding,``Joint Blind Equalization and Carrier Recovery of QAM Systems," Proc. 25th Conf. on Info. Sciences and Systems, Baltimore, MD, March 1991.

[215] R. A. Kennedy, B.D.O. Anderson, Z. Ding, and C. R. Johnson, Jr., ``Local stable minima of the Sato recursive identification scheme", Proceedings of the 29th IEEE Conference on Decision and Control, vol.6, Page(s):3194 - 3199, 5-7 Dec. 1990.

[216] Z. Ding, C. R. Johnson, Jr., and R. A. Kennedy, `` Nonglobal convergence of blind recursive identifiers based on gradient descent of continuous cost functions", Proceedings of the 29th IEEE Conference on Decision and Control, vol.1, Page(s):225 - 230, 5-7 Dec. 1990.

[217] Z. Ding, C. R. Johnson, Jr., and R. A. Kennedy, ``On the admissibility of blind adaptive equalizers", Proc. Int. Conf. on Acoustics, Speech, and Signal Processing, vol.3, Page(s):1707 - 1710, 3-6 April 1990.

[218] Z. Ding, C. R. Johnson, R. A. Kennedy and B. D. O. Anderson, ``On the Ill-Convergence of Godard Blind Equalizers in Data Communication Systems", In Proceedings of Conf. Information Science and Systems, vol. 89, pp. 538-543, Baltimore, MD, 1989.

Professional Services and Achievements

- Steering Committee Chairman, *IEEE Transactions on Wireless Communications,* 1.2008-1-2010
- Canadian National Science and Engineering Research Council Panelist, 2009-2012
- Fellow of IEEE
- Steering Committee Member, *IEEE Transactions on Wireless Communications,* 1.2006-1-2008
- General Chair, IEEE 2016 International Conference on Acoustics, Speech, and Signal Processing, Shanghai, China.
- Technical Program Chair, *IEEE 2006 Globecom*, San Francisco, CA.
- Editorial Board Member, *IEEE Signal Processing Magazine*, 1/2003-1/2007.
- Associate Editor, *IEEE Signal Processing Letters*, 1.2002-1.2005.
- Associate Editor, IEEE Transactions on Signal Processing, 1.2001-1.2004.
- Editor, Special Issue on Multiuser Detection and Blind Estimation, *EURASIP Journal on Applied Signal Processing*, Dec. 2002.
- Member, IEEE Statistical Signal and Array Processing Technical Committee, 1993-1998.
- Member, IEEE Signal Processing for Communications Technical Committee, 1998-2004.
- Associate Editor, IEEE Transactions on Signal Processing, 1994-1997.
- Technical Program Committee Member, 3rd IEEE Workshop on Signal Processing Advances in Wireless Communications, Taiwan, March 2001.
- Organization Committee Member, 1st IEEE Workshop on Signal Processing Advances in Wireless Communications, Paris, France, April 1997.
- Review Panelist, National Science Foundation, 1997, 2003, 2004, 2005, 2007, 2008, 2010, 2014, 2015, 2016.

Appendix B

Appendix B

Materials Considered

Document Productions:

PRODBEG	PRODEND
HW_Samsung_00095619	HW_Samsung_00095630
HW_Samsung_00113804	HW_Samsung_00113822
HW_Samsung_00119046	HW_Samsung_00119065
HW_Samsung_00120556	HW_Samsung_00120574
HW_Samsung_00122730	HW_Samsung_00122740
HW_Samsung_00388341	HW_Samsung_00388361
SAMSUNG-HNDCA-000000280	SAMSUNG-HNDCA-000000299
SAMSUNG-HNDCA-000000300	SAMSUNG-HNDCA-000000323
SAMSUNG-HNDCA-000000346	SAMSUNG-HNDCA-000000361
SAMSUNG-HNDCA-000000388	SAMSUNG-HNDCA-000000408
SAMSUNG-HNDCA-000000409	SAMSUNG-HNDCA-000000430
SAMSUNG-HNDCA-000000431	SAMSUNG-HNDCA-000000451

Other:

- 2018.04.27 Expert Report of Michael A.M. Davies
- 3GPP TS25.213 V14.0.0 (2017-03)
- 3GPP TS 36.211 V14.2.0 (2017-03)
- 3GPP TS 36.211 V14.6.0 (2018-03)
- 3GPP TS 36.212 V14.4.0 (2017-09)
- 3GPP TS 36.213 V14.2.0 (2017-03)
- 3GPP TS 36.321 V14.4.0 (2017-09)
- 3GPP TS 36.322 V13.2.0 (2016-06)
- 3GPP TS 36.331 V15.1.0 (2018-03)
- 3GPP TS 45.008 V14.3.0 (2018-03)
- CN100571106C (2006-03-22)
- CN102215085A (2010-04-7)
- CN102282819A (2009-01-13)
- EP 1105991 B1 (1998-08-17)
- EP 1230818 B1 (1999-11-17)
- EP 2119287 B1 (2007-02-28)
- EP 2229744 B1 (2008-01-08)
- EP 2485514 B1 (2007-02-28)
- KR20080096351A (2007-04-27)
- R1-080870 - TSG-RAN WG1 #52 (2008-02-11-2008-02-15)
- R1-081110 - TSG-RAN WG1 #52 (2008-02-11-2008-02-15)

- US Patent No. 8, 243,669 B2 (2012-08-14)
- US Patent No. 8,797,967 B2 (2014-08-05)
- US Patent No. 9,807,741 B2 (2017-10-31)
- US Patent Application Publication No. 2009/0285122 A1 (2009-11-19)
- US Patent Application Publication No. 2009/0303956 A1 (2009-12-10)
- US Patent Application Publication No. 2010/0322114 A1 (2010-12-23)
- US Patent Application Publication No. 2011/0242997 A1 (2011-10-06)
- US Patent Application Publication No. 2013/0028192 A1 (2013-01-31)